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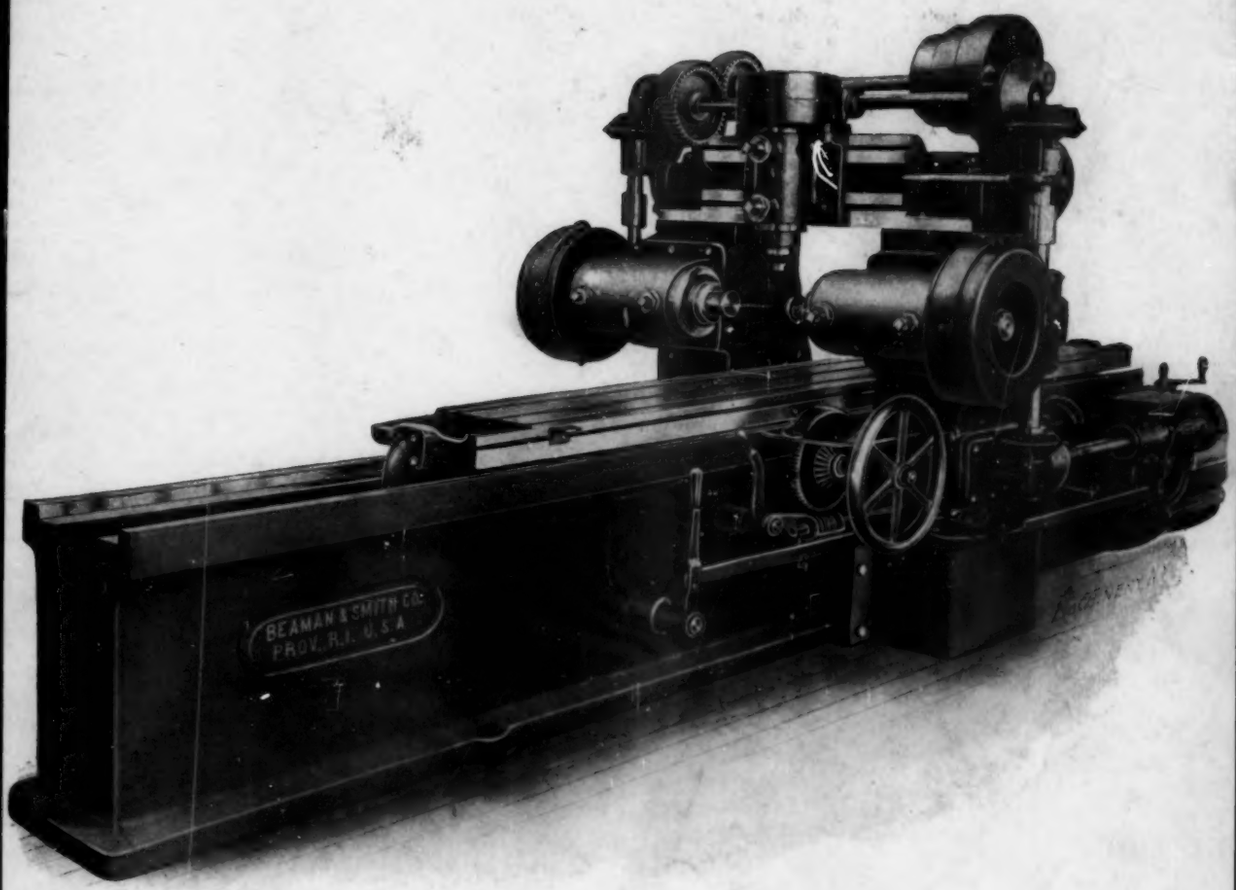
AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,
505 PEARL STREET, NEW YORK.
Vol. 30. No. 1.

Index to Advertisers and Classified Index Following Reading Matter.



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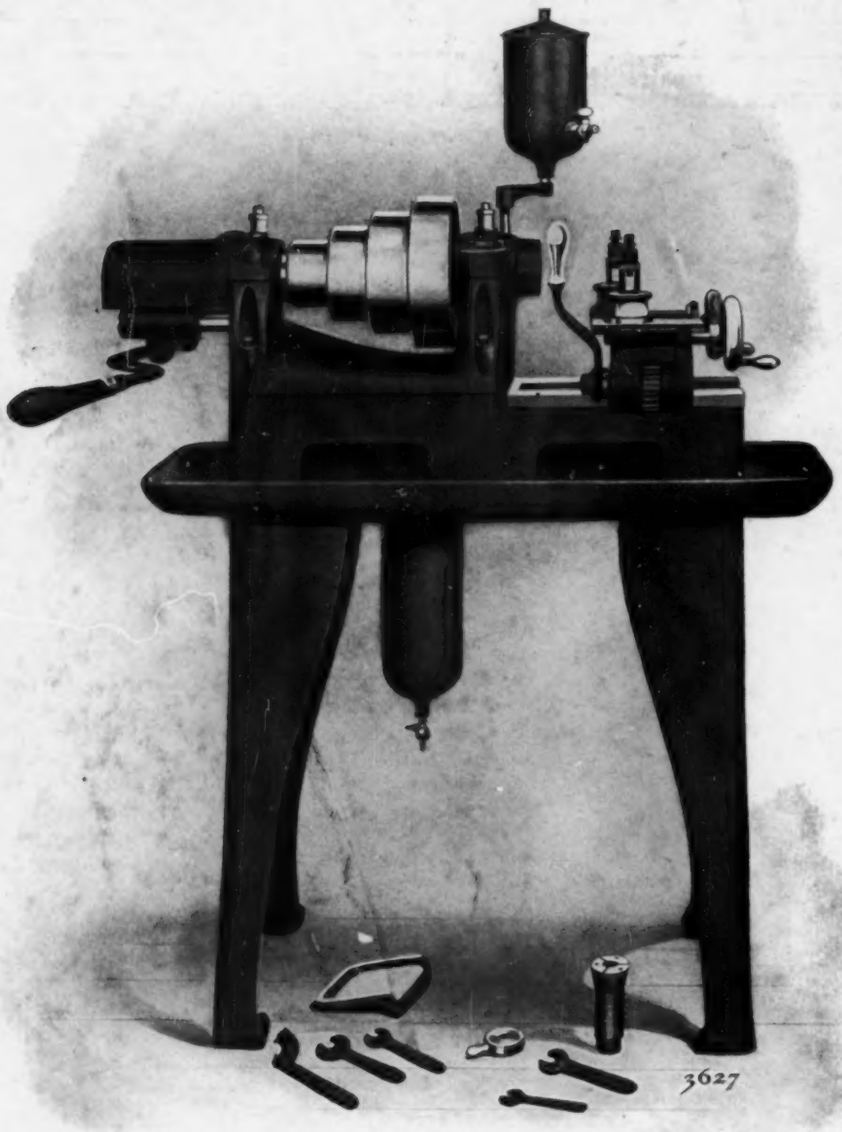

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ELECTRICALLY HEATED ANNEALING AND HARDENING FURNACE

Perfect Control of Temperature Assured

BY OUR BERLIN CORRESPONDENT

One of the most important desiderata in modern metallurgical practice is to have a means of heating metal samples in a perfectly uniform manner and to maintain their temperature at any point desired. Such annealing furnaces as have been in use up to now, in which a lead or salt bath is heated indirectly or directly by means of gas or coal, fail to afford the desirable safety as to a uniform heating effect, nor are they susceptible of an accurate adjustment to the most advantageous temperature in each case. Unless electric heating from within be resorted to, it proves especially difficult to raise the bath to and to maintain it at a temperature of 1300 degrees Centigrade, as required for the hardening or annealing of high-speed tool steels, no materia1 crucibles are made of being able permanently to stand this enormous heating effect from the outside. In the case of a non-uniform heating, such as occurs especially with steel samples having irregular cross sections, deformations of the heated parts in cooling as well as internal strains, cracks, etc., will moreover be the result.

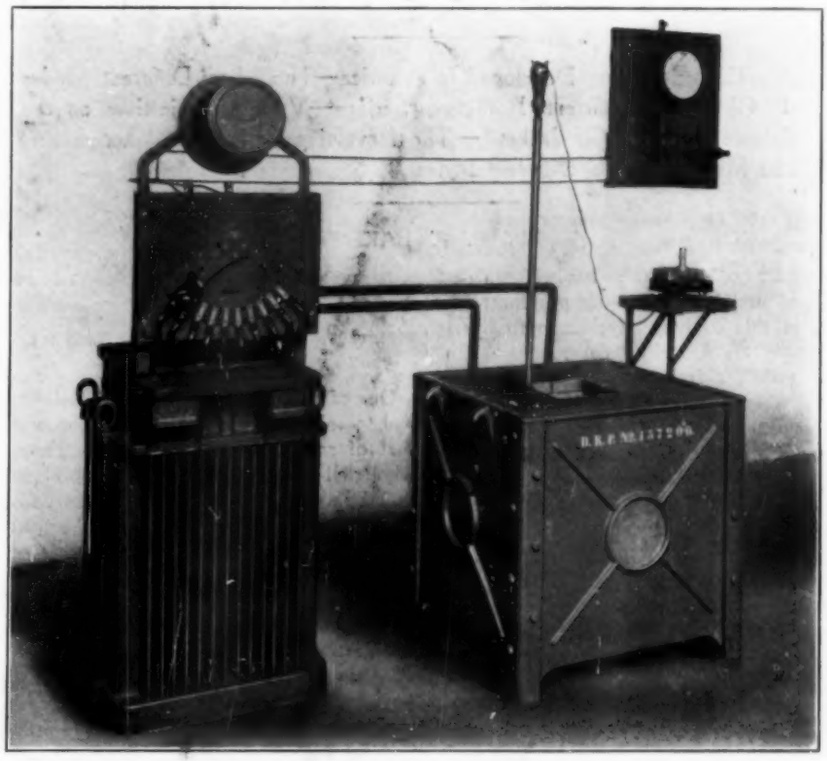
DESCRIPTION OF THE FURNACE

The electric annealing furnace, recently constructed by Gebr. Körting, Elektricität, Limited, will raise metal salts or mixtures of such to a liquid incandescent condition by the aid of electric currents. This salt bath receives the samples to be annealed and, being traversed by the current throughout its mass, is heated with perfect uniformity in all of its parts. By means of an easy regulation of the current intensity any temperature intermediary between 750 and 1325 degrees Centigrade may be imparted to the annealing bath and to the samples to be annealed.

This electric furnace comprises a fireproof casing rectangular in shape for receiving the salt bath, which casing is fitted into an iron box lined with fire-resisting mortar. Wrought-iron electrodes supplying the single-phase current to the salt bath are fitted to two inside walls of the casing, opposite one another. These electrodes are connected by wrought-iron bars to a transformer by which the available electrical energy is converted to the low tension at which it is to be used. By inserting or cutting out some windings in the primary circuit of the transformer the temperature is regulated in the most simple manner. To operate the furnace an ammeter, a main switch and safety fuses are required. The regulating transformer provides tensions of 5 to 25 volts, as required in keeping the temperature constant to be readily adjusted for, while yielding the higher tension of 50 to 55 volts, as temporarily necessitated in preheating the bath.

In order to start the melting process and to heat the bath, a movable auxiliary electrode is used, the metal salts being nonconductive in the cold condition and reaching a high conductivity only in the incandescent liquid condition. This auxiliary electrode, beginning from one of the electrodes, slowly carries a liquid vein to the other. The salt bath is heated by the electric current to the temperature required, which is kept constant by regulating the transformer.

In the case of a constant primary tension the current consumption read from the ampere meter enables the temperature of the bath to be gaged.



A GERMAN ELECTRICALLY HEATED ANNEALING AND HARDENING FURNACE

EFFICIENCY AND UNIFORMITY OF ACTION OF THE FURNACE

As the electric current, traversing the salt bath, immediately produces the heating effect in all its parts, the thermal efficiency of the furnace thus heated is very high as compared with the ordinary types of annealing furnace. The temperature insured by electricity is moreover far more uniform than in the case of gas or coal fires, there being no fall in temperature from the walls of the bath or the muffle.

Whereas ordinary melting furnaces are rapidly destroyed under the influence of the high temperature and the action of the fire gases, the consumption of wrought-iron electrodes, as occurring in the electrically heated furnace, involves far less expense. The temperature is furthermore ascertained accurately and readily by means of a pyrometer, owing to the uniform distribution of temperatures. For the same reason, the samples may be annealed without risk of superheating or of burning edges and points. In the case of expensive pieces there is therefore no possibility of the sample becoming unfit for use after cooling.

RAPIDITY OF ACTION OF THE FURNACE

The output of the electric furnace is many times greater than that of ordinary furnaces, the samples being raised to the proper temperature in about one-fifth of the time required in the case of gas furnaces. It may further be said that the

surface of the samples is not altered as in the case of the latter.

Other features of the electric furnace are its absolute fireproofness and the absence of smoke or soot, as well as of poisonous gases, such as rise from lead or potassium cyanide baths.

The temperature required for the hardening of ordinary tool steel does not exceed 850 degrees Centigrade, while temperatures intermediary between 1000 and 1150 degrees, and in certain cases as high as 1300 degrees Centigrade, will prove necessary for the annealing of high-speed tool steel.

According to the special use they are intended for, the furnaces are accordingly designed for a maximum temperature of 850, 1150 or 1300 degrees Centigrade.

The approximate consumption of energy is shown in the following table, which relates to the standard types of furnace constructed by Messrs. Körting.

Temperature. Deg. C.	SIZE OF FURNACE—mm. 120x120 x 120	150x150 x 170	200x200 x 270	300x300 x 370
850	3	4.5	8.5	20
1150	5.5	9	16	36
1300	7.5	12	22	48

APPROXIMATE CONSUMPTION OF ENERGY IN KILOWATTS

PATTERNMAKING AND MOLDING OF AIR-COOLED GAS-ENGINE CYLINDERS

The Air-Cooled Engine Developed in America—The Many Different Modes of Obtaining Sufficient Radiating Surface—Various Projections on the Cylinder—The "Air Jacket"—The Revolving Cylinder—Patternmaking and Molding of the Different Styles

BY E. F. LAKE*

The air-cooled cylinder having been developed and brought to its present position in this country, lays claim to being distinctly an American development. In this it differs from the water-cooled design, which was brought to its present state of development in Europe, principally in France, Germany and England, and nearly all of the ideas in use on the water-cooled cylinder were first perfected on the other side and then brought over here and copied by our automobile engineers and manufacturers. With the air-cooled cylinders, however, American ingenuity and inventive ability have been brought into activity, and where the European engineer cast aside the air-cooled as impractical the American engineer has taken it up and developed it, and brought it into practical use, on the theory that on an automobile where a fresh supply of water cannot be continuous, but the same water must be used over and over again until in some cases it comes to the boiling point, it is more practical and economical to cool the cylinders with air, of which a fresh supply can always be obtained. This theory, like most others, has proved a success in some cases, and a failure in many others.

Automobile engines of the four-cylinder four-cycle type of 40-horse power are being air-cooled and run successfully. That would be 10 horse-power to each cylinder, and it is difficult to cool them with water when they get much larger than that, that is, for motor-car use, owing to the extra bulk and weight of water which has to be carried.

THE PROVIDING OF RADIATING SURFACE ON AN AIR-COOLED CYLINDER

One of the problems which the designer had to solve on the air-cooled engine was that of radiation and convection. Those who tried to get along with radiation alone failed, as whether flanges, pins, wire coils or what-not were used to carry the heat from the cylinder wall to the outside of the radiating surface, the heat would stay there and back up at the cylinder and cause overheating, then the piston would stick and the engine refuse to go any further, as the air does not readily absorb heat, and will not take it from the flanges etc., unless convection is used. This principle was brought into play by the use of a fan or blower connected to the crankshaft of the engine forcing a current of air against the cylinders, which wiped the heat from the flanges, pins, wire coils, etc., as you would wipe the moisture of condensation off a window pane with a piece of cloth. Convection is necessary to carry the heat away in a continuous current, and the flanges, pins, etc., etc., are used to spread the heat out over a large surface, so it can be taken up and carried away easily.

THE USE OF FLANGES

There are many different methods used for increasing the cooling surface of the cylinders. The one of which we see the most at the present day is the wide, thin flange running around the cylinder and cast integral with it, with other flanges running over the top, as shown by Figs. 1 and 2.

PINS TO INCREASE THE SURFACE

While the iron cylinder with its flanges cast integral is the most common, many other ways have been tried, some of which are in use. Next to the flanges, with regard to the number of engines on which they are employed, comes the use of pins, which may be round, oval, square, oblong or any shape desired. These pins are put on in various ways: some are cast integral with the cylinder, which makes quite a difficult job for the molder and patternmaker; some drill and tap

FIG. 3. Cross-Section showing Removable Strips of Pins on Barrel, in Core-Box Construction

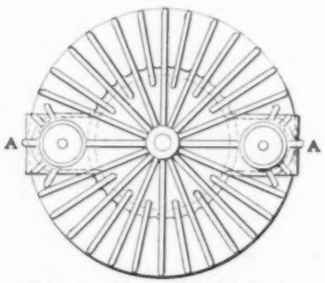


FIG. 2. Plan of Ribbed Cylinder

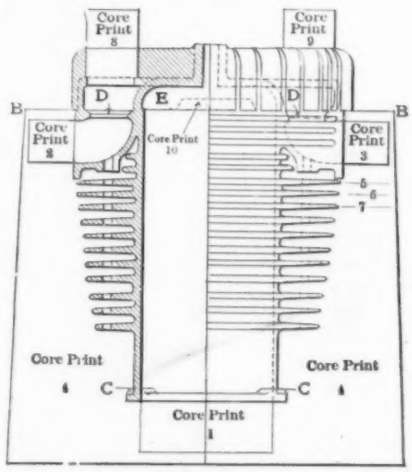


FIG. 1. Air-Cooled Cylinder with Flanges and Ribs

holes in the side of the cylinder and screw in the pins which are threaded on the large end. This necessitates thicker metal on the body of the cylinder, and much care must be taken not to break through the side wall of the cylinder in drilling, as it would cause a leakage. Sometimes these pins have a groove cut in one side to add to the cooling surface.

HOLLOW PINS

Another form is to screw tubing into the tapped holes, said tubing having a

*A previous article by the same author on this general subject was published at page 430.—Ed.

wide slot cut down the side to allow the air to pass freely out of the center of the tube. These pins or tubes are placed very close together and make the cylinder resemble a porcupine in action.

COMBS

Another style, and one which, like the pins, gives the cylinder a porcupine appearance, is to make dovetailed slots up and down the sides of the cylinder and insert in each slot a strip having teeth, like a very coarse-toothed comb, say from 8 to 10 teeth in the length of the cylinder. The second strip put in could have the teeth come opposite the opening between the teeth of the first strip and so alternately around the circumference of the cylinder. After these strips are inserted, and sometimes when the loose pins or tubes are used, they are given a copper plating to fill up the cracks which come at the joints, as any opening between the two pieces of metal, no matter how slight, or a film of grease or other substance, retards conduction, holding the heat on the inside of the cylinder.

OTHER METHODS OF INCREASING RADIATING SURFACE

Another style used is to cut a small slot lengthwise of the cylinder, or where there are no projections on the outside circumference the slots can be turned in the lathe, and strips of copper, brass or aluminum (copper being the best as it is the best conductor of heat) are bent over so that a sectional view would make it look like a hairpin. These are then pened or hammered into the slots with copper or brass wire laid in the V of the sheet metal, which on hammering flattens out and fills up the slot.

Many interesting and curious ways of increasing the radiating surface have been used, one of which is a square-sectioned copper wire of about 3/32 of an inch thick which has been bent up in a continuous coil of an oval triangle shape similar to that shown in Fig. 4. A flat band of copper is passed through the coil and then wound around the cylinder, the coil, band and cylinder being connected together by giving the whole a heavy plating of copper.

Copper flanges have been brazed to cast iron and steel cylinders.

CASTING COPPER OR ALUMINUM FLANGES ON AN IRON CYLINDER

Another novelty in the way of putting on the flanges was brought out by a French manufacturer; the flanges were cast separate, as this would insure good flanges, and they could be cast of iron, copper, aluminum or any other metal desirable. The pattern was then made large enough so the flanges could be placed in the mold and sand packed in between them. The mold was then heated until the flanges in it were brought to the point where they would fuse with the hot iron. The iron was then poured in, which completed the casting. This manufacturer was enabled in this way to cast aluminum flanges on a cast-iron cylinder and made the cylinder lighter by that much.

COMPARATIVE MERITS OF DIFFERENT METHODS

All of these ways, however, are much more expensive than the flanges or pins cast integral with the cylinder and give

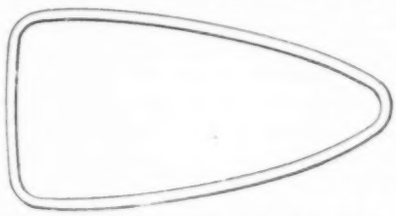


FIG. 4. SECTION SHOWING FORM OF WIRE COIL

no better results as far as cooling is concerned. Something has been gained, however, in weight by the substitution of aluminum for iron wherever possible and those who are carrying on the aëronautical experiments do not object to the cost of an engine, if they can save in weight, and the first question they would ask is how much does it weigh per horse-power?

The automobile manufacturer, on the other hand, must be shown that the saving effected in weight will warrant the extra expense, while the boat manufacturer wants to cut down the cost as much as possible without sacrificing quality, and weight does not make so much difference with him as with the other two.

THE "AIR-JACKET"

There is another principle of air-cooling, however, which is being used successfully and by quite a number, and that is by jacketing the cylinders with sheet metal and forcing a current of air through it. With this style, flanges or pins are not so necessary and are only present in a crude form, if at all. Fig. 5 gives an illustration of this form and, as you will see, the cylinders are each cast separate as it is essential to do so in order to get a current of air between them. The circulation of air is started by the fan or blower *A*, Fig. 5, which is driven from the crank-shaft by gears *B B*, to give it the proper speed, through a ratchet *C*, so that if the engine is stopped suddenly the fan can keep moving until it has spent itself. This prevents any harm coming to the fan blades from a sudden stop and also keeps a cooling current of air circulating around the cylinders as long as possible. With this arrangement the air current is started circulating as soon as the engine starts to generate heat and the faster the engine runs the faster will be the current of cool air to carry away the heat. One American manufacturer has placed on the market a four-cylinder engine the cooling of which is based on this principle and in which the user can employ either water or air for cooling. In this case he has put in a blower which can be used as a centrifugal pump when water is used.

THE REVOLVING-CYLINDER ENGINE

Another principle that is used in air cooling successfully, having been in use for several years and marketed all over the country for the past two years, is the revolving cylinder; as shown by Fig. 8 this has a vertical stationary crank-shaft, with the cylinders spinning around it like a top. In this case it is being made in three- and five-cylinder engines, an odd number being necessary in this design because of the self-starting feature of the

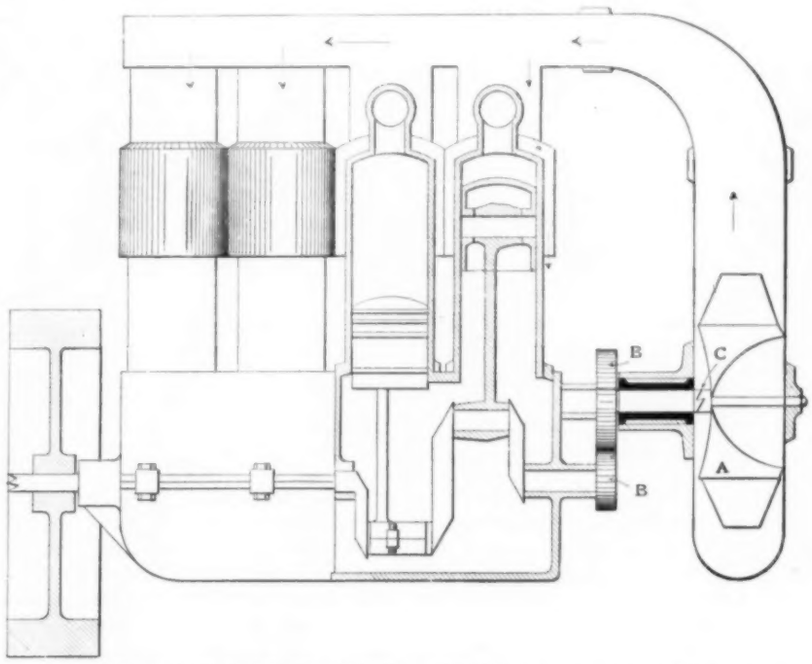


FIG. 5. ENGINE WITH AIR-JACKETED CYLINDERS AND FAN-BLOWER

engine. This engine cylinder has flanges about two inches wide running lengthwise of it and around the end. The cylinders themselves revolving, they are continually in contact with a fresh current of air, hence do not need a fan or blower, neither do they need to be inclosed in a case to direct the air against the sides of the cylinder, as, if the cylinders are in the open a greater supply of fresh air is available than if inclosed. This style of engine also does away with the fly-wheel as the revolving cylinders themselves do the work of the fly-wheel. Two other styles of engine have been brought out using this principle, but having the stationary crank-shaft placed on a horizontal instead of a vertical line. The arguments advanced against this style of engine are that the centrifugal force will carry the oil away from the piston and that the vibration is great, but not having used one of these cars, I am not ready to make those charges, as it is only by a thorough test that these questions can be answered positively.

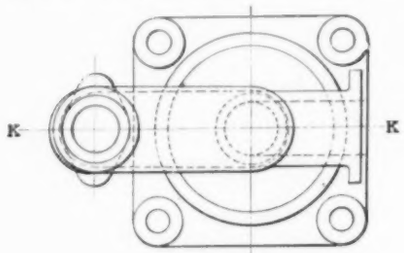


FIG. 6. Plan

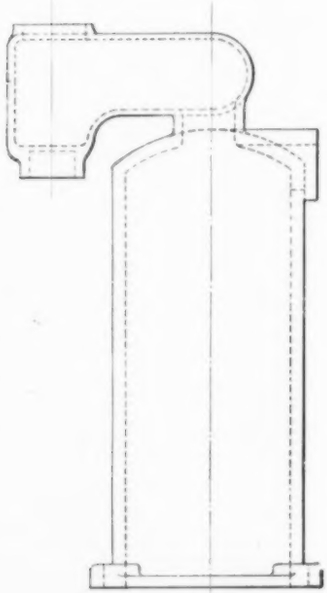


FIG. 7. Side Elevation

CYLINDER CAST WITHOUT PROJECTIONS

FANS

Air-cooled engines of the smaller sizes, say up to three horse-power per cylinder, are run successfully without a fan, but the majority of the larger sizes that use flanges, pins, etc., either have a fan in front blowing backward, or a fan on top blowing downward. Where the fan in front is used it may interest some to know that the cylinder closest to the fan is the hottest, while the one farthest away is the coolest. The reason for this is that the ends of the fan blades throw out the largest volume of air, which strikes the rear cylinder, while the nearly dead center of the blades do not cause as much air to circulate, hence the front cylinder does not get the amount of circulating air that the rear does and is a trifle warmer.

THE PATTERNMAKING AND MOLDING OF A CYLINDER WITH COOLING FLANGES

A large amount of experience and skill is necessary in the making of the pattern and the molding of the cylinder with flanges as illustrated by Figs. 1 and 2, since the flanges are not over ⅛ inch in thickness at the outer edge and they have been made 3/32 inch by some; from the cylinder body to the outer edge of the flange is from 1¼ to 2 inches according to the size of cylinder; therefore, great care must be taken by the molder in order to prevent a large percentage of loss, owing to the iron not running in the flanges.

If the flanges over the top of the cylinder were run at right angles to the line *A A*, Fig. 2, the pattern could be split on the center line *A A*, and molded on its side, which would allow the entire core to be made in two halves, pasted together and located in core prints 1, 2 and 3, Fig. 1, but this would cause the flanges to come bad on one side of the casting, it being a difficult job to make the iron rise in the cope of the mold, and fill the numerous flanges along the body of the cylinder as it would mean too much work for the molder to put a riser in for each flange; and to give it enough vent with the vent rod would tear up the mold too much and produce rough castings; if neither were done air pockets would form and prevent the iron from running.

It could also be molded by parting the pattern on the lines *B B* and *C C*, Fig. 1, and molding in a three-part flask. If made in this way, a barrel would have to be turned up for that part of the pattern between the lines *B B* and *C C*, Fig. 1, which would come in the cheek or middle part of the mold, and each flange made in several pieces and pinned to the barrel with loose pins. Then by drawing the barrel out of the mold first, each piece of flange could be drawn into the opening left by the barrel and thence out of the mold. This would enable it to be cast on end which would insure good flanges, and if molded with the top of the cylinder down it would also insure the best iron in the mold at the valve seat *D D*, and in the compression chamber *E*, but it would be a very tedious job for the molder to ram the sand around the flanges without leaving a joint in the casting where the flange was split. A better way would be to put a large core print on the pattern as shown by core print 4, Fig. 1, and build

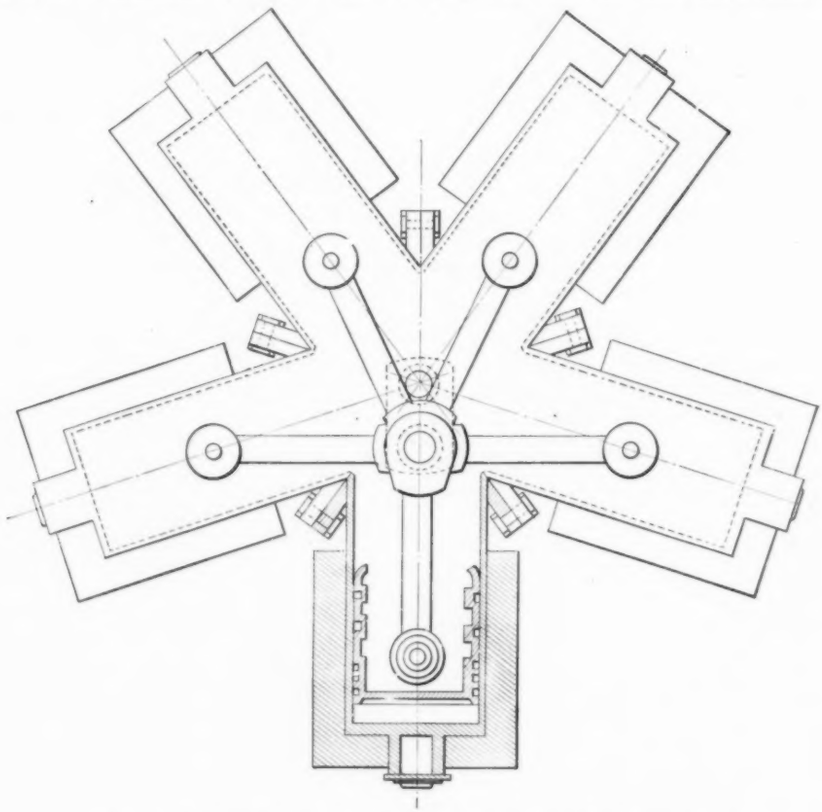


FIG. 8. SECTIONAL PLAN OF ENGINE WITH REVOLVING CYLINDERS

up the mold from the line *B B*, with cores parted on the center line of the flanges, as at 5, 6 and 7.

PRACTICE RECOMMENDED—TO MAKE ALL IN CORE-BOX

But what appears to me as the best way would be to make the whole thing in a core-box. This core could be parted on the line *B B*, so as to get the inlet and exhaust passages and the compression-chamber cores in. These could all be made in one core and located by core prints 8 and 9 in the outside core above the line *B B*, and the whole placed in the

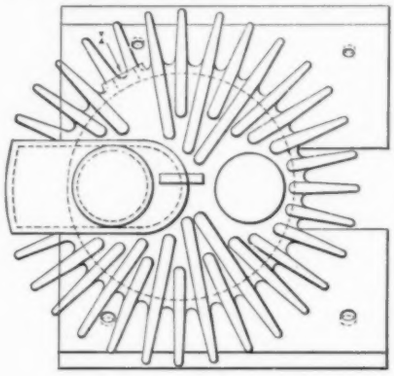


FIG. 9. End of Cylinder

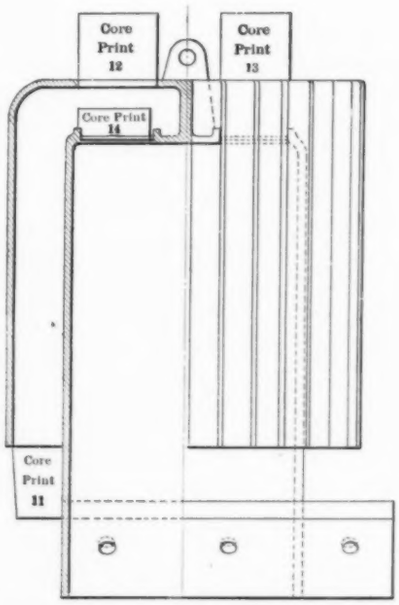


FIG. 10. Section on Plane Parallel to Axis

ENGINE CYLINDER OF REVOLVING TYPE

mold, then the part below the line *B B* could be placed on top of that either in one core or in a series of cores by making a separate core for each flange, then the barrel core for the center could be located in core print 10, and held in the cope by core print 1, and the mold is ready to close and pour. This would allow it to be cast on end with the top of the cylinder down so that the best iron would come around the valve seats and compression chamber. It would prevent the formation of air pockets in the flanges and allow the iron to run in, and by having it all in dry core sand instead of in damp molding sand, the iron would flow freely and fill up all the cavities of the mold and if desired the mold could be heated before pouring the iron in.

MAKING A CYLINDER WITH PINS

Where pins instead of flanges are cast on the cylinder, the same rules hold good, except that a barrel would have to be turned up and a row of pins fastened to two strips and pinned to the barrel around its entire circumference, as illustrated by Fig. 3, so the barrel could be drawn out of the mold or core-box and the strip of pins drawn to the center opening left by the barrel and then out of the mold.

MOLDING THE REVOLVING CYLINDER

The cylinder of the revolving-cylinder engine, as shown by Figs. 9, 10 and 11, is much easier to mold than the last one described, owing to its having flanges that run lengthwise of the cylinder instead of around its circumference, but this style of flange is not practicable on the stationary-cylinder engine as a few flanges would catch the currents of air sent from the fan and shut them off from the rest of the cylinder, resulting in one side of the cylinder being cool while the other side was hot.

By parting the pattern on the lines *G G* and *H H*, Fig. 11, it can be molded on end with the inlet and exhaust ports and the compression chamber in the drag. The flanges can all be fastened to the pattern, and there would be no loose pieces on the pattern except the boss for the spark plug shown at *I*, Fig. 9. After the cope and cheek have been removed the mold would be parted on the line *G G*, Fig. 11, and a straight draw will lift the pattern out. This pattern would give much better results if it were made of metal, as it would leave the sand much more freely in drawing and the flanges would not need as much draft from the line *G G* to *J*, Fig. 11, as it would if made of wood. After the pattern is drawn the inlet core could be set in core print 12, Fig. 10, and the cheek put on, which would close down over core print 11. Then the barrel core could be put in and located by core prints 13 and 14, Fig. 10, after which the cope could be put on, which would close down over core print 15 and, after clamping, the mold would be ready to pour the iron in.

MAKING THE CYLINDER UPON WHICH FLANGES AND PINS ARE NOT CAST

The cylinder which goes on the engine with the sheet-metal jacket around it, through which the air is blown by a fan or blower as shown in Fig. 5, and the cylinder in Figs. 6 and 7 can also be used when pins are screwed in, or when it is slotted and the comb-like teeth inserted, or when it is grooved and the sheet metal bent like a hair pin and pened in the groove with a copper wire, etc., etc. These styles would need a different inlet and exhaust-port design and a little thicker metal on the sides to stand drilling, slotting and grooving. It is very easy to make the pattern of this cylinder and to mold it, as it can be split on the line *K K*, Fig. 6, and the core made in two halves and pasted together and located in the mold by four core prints at the four different openings.

ANOTHER DESIGN OF RADIATING SURFACE

Another novelty in air-cooled engines has just come to my notice and it is the use of copper wire bent in the form of

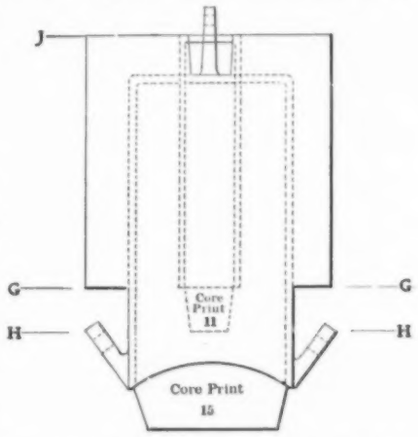


FIG. 11. SECTION OF REVOLVING CYLINDER ON PLANE PERPENDICULAR TO AXIS

small coiled springs and screwed into the wall of the cylinder, making it look like a spring bed with the mattress off and rolled up.

The Penn Steel Casting and Machine Company, Chester, Penn., has recently made some cast-steel locomotive cylinders for the New York Central & Hudson River Railroad Company. To ascertain the resistance of the material to shock, a cylinder was sent to the United States naval proving ground, Indian Head, Md. Three shots in all were fired through and into the cylinder, two from a one-pounder and one from a three-pounder. The test was entirely satisfactory, no cracks developed. The physical test of the material is as follows: Tensile strength, 76,000 pounds; elastic limit, 36,000 pounds; elongation in 2 inches 28.5 per cent., with 34.6 per cent. reduction in area. Hydrostatic test, 700 pounds per square inch.

The Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, without demand, request or information from its men that they desired an increase in their wages, decided that an advance of 1½ cents per hour was due them, and made that advance commencing December 3. This means the addition of $30,000 to a payroll which already exceeds $500,000 annually.

THREAD-CUTTING TOOLS— METHODS OF MAKING AND USING

Holders and Fixtures for Single-Pointed Thread Tools and Chasers—Grinding and Shaping Devices —Measuring Threads—Making Threading Dies, Etc.

BY R. A. ALMOND

Some time ago we had a large order for a complete set of plug and ring gages with taps and dies for standard and special threads. Now we had some experience once before with an order of this kind that gave us a lot of trouble, and it was a long time before we could find out where to locate it. When we compared our gages with the master gages given us to work to, they would not go together. They measured exactly the same in the thread angle at the top, bottom, etc., but would not enter the same. When we got this order, it was pointed out by our customers that their master gages and ours must compare. We sent an expert out to visit different shops doing nice thread cutting, and the only point he could obtain was that the chaser must be planed in a shaper with a single-point thread tool. That was all we needed, and two men were at once set to work to devise the best possible method of getting out the job regardless of expense. By thoroughly examining our own gages it was found that the flats of our thread chaser did not have perfectly sharp corners.

Now that point makes all the difference in the world. When we have a screw plug with perfectly sharp corners for the flats, and the ring gages have slightly rounded corners at the bottom and top, the plug will not enter right, even if it measures exactly right everywhere else. I will now try to explain our system, which can be used for both sharp and U. S. standard threads.

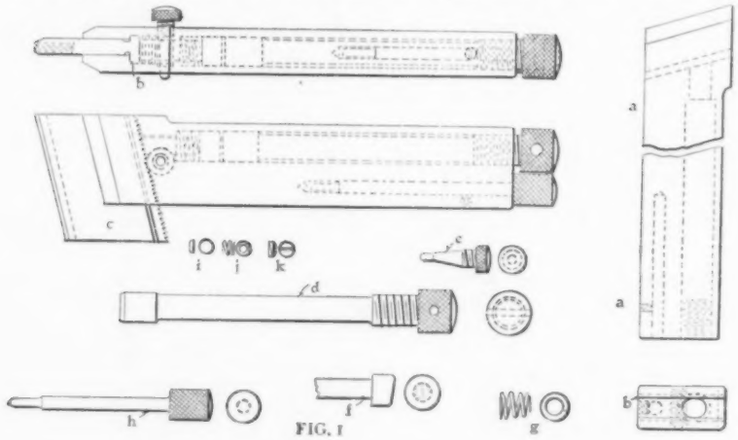


FIG. 1

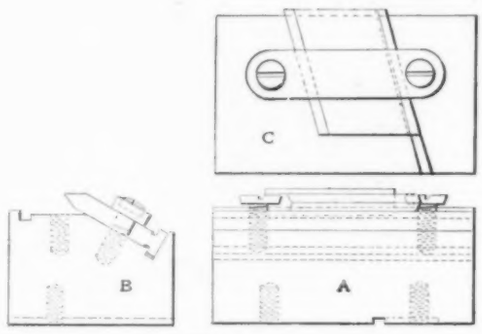


FIG. 2

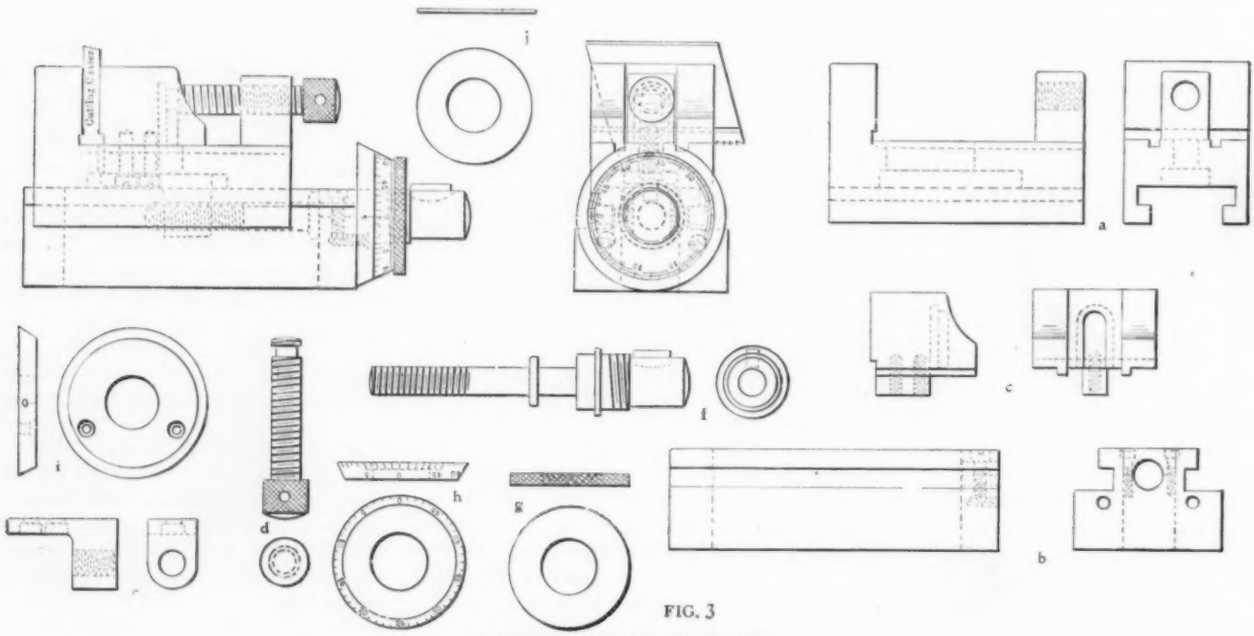


FIG. 3

CHASER TOOLS AND FIXTURES

A THREAD TOOL HOLDER

The first thing we had to do was to design a thread tool holder. We have used different kinds, but they all seem to have a weak point somewhere. This tool holder seems so far to have overcome every obstacle. Its construction is shown in Fig. 1. It has a tool-steel body *a* planed all over

and drawn to a spring temper. In the front end *b* is milled a T-shaped slot at an angle of 10 degrees to receive the back of the tool *c*, which requires to be a good fit along the sides of the blade, but not on the T-head. This fit is secured after the holder is hardened, the sides of the groove being lapped to a sliding fit for the chaser. Through nearly the entire length of the holder is drilled a 3/8-inch hole, which is tapped at the rear end only to receive the nurled-head screw *d*, which serves to hold the thread tool securely and yet allows the latter to be removed for grinding without removing the holder from the tool post. After grinding the tool is set back exactly level with the top of the holder, which is ground and lapped straight. The tool is adjusted by a taper screw *e*, which is placed underneath the ratchet plug *f*, which lies in an elongated hole at the front of body *a*; the back end of the plug is finished on an angle of 10 degrees so the front end will tip down in its pocket before the thread tool is in place.

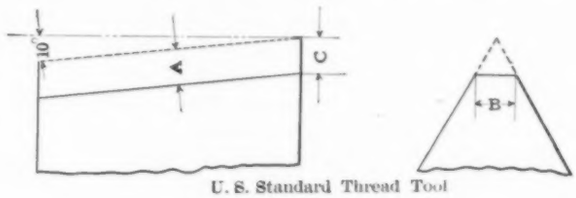
ADJUSTING THE THREAD TOOL IN ITS HOLDER

In adjusting, screw *e* is left out a little way, and when the tool is within 1/64 inch of the top of the holder the screw *d* is turned enough to hold the tool in place. Now the screw *e* is adjusted until the top of the tool is flush with the top of the tool holder, then the nurled pin is used to tighten the screw. Between the head of plug *f* and the bottom of the hole, is a spring *g*, which forces the plug when the clamp screw is released. A 3/16-inch hole is drilled in the holder to receive the pin *h* which is held in place by plug *i*, spring *j*, and screw *k*. A narrow shoulder is left in the bottom of the hole to keep the spring plunger from dropping through.

MAKING THE RATCHET TEETH IN THE CHASER BACKS

The single-pointed thread tools and chasers are made in the customary way, but a few words may be said in regard to making the ratchet cuts in the backs of these tools. These might be milled out with an angular cutter, but we found this to be very slow and expensive.

We used strips 12 inches long and after these had been planed to T-shape leaving 0.010 inch for grinding, the ratchet teeth were formed in a shaper with a Novo side tool ground to the required shape. In this operation a stop is clamped on the rail about ½ inch from the point at which the cut is to be started, and the feed set for five teeth. The saddle is moved back to the stop, and the screw handle turned forward until it is in a horizontal position. The shaper is then started, and upon



U. S. Standard Thread Tool

Thread Per Inch	Pitch	A	B	C	Double Depth	Depth	Thread Per Inch	Pitch	A	B	C	Double Depth	Depth
1	1.000	.1064	.125	.1082	1.299	.6495	33	.0303	.00315	.0037	.0032	.0393	.0196
2	.5000	.0532	.0625	.0541	.6495	.3247	34	.0294	.00307	.0036	.0031	.0382	.0191
3	.3333	.0355	.0416	.0360	.433	.2165	35	.0285	.00295	.0035	.0030	.0370	.0185
4	.2500	.0266	.0312	.0270	.3247	.1623	36	.0277	.00289	.0034	.00295	.0360	.0180
5	.2000	.0213	.0250	.0216	.2598	.1299	37	.0270	.00281	.0033	.00286	.0350	.0175
6	.1666	.0177	.0208	.0180	.2165	.1082	38	.0263	.00272	.00325	.00282	.0341	.0170
7	.1428	.0152	.0178	.0154	.1855	.0927	39	.0256	.00268	.00320	.00277	.0333	.0166
8	.1250	.0133	.0156	.0135	.1623	.0812	40	.0250	.00264	.00312	.00270	.0324	.0162
9	.1111	.0118	.0138	.0120	.1443	.0721	41	.0243	.00255	.00306	.00262	.0319	.0159
10	.1000	.0106	.0125	.0108	.1299	.0649	42	.0238	.00251	.00295	.00257	.0309	.01545
11	.0909	.00963	.0113	.0098	.1180	.0592	43	.0232	.00247	.00290	.00251	.0302	.01520
12	.0833	.00886	.0104	.0090	.1082	.0541	44	.0227	.00238	.00283	.00245	.0295	.0147
13	.0769	.00818	.0096	.0083	.0999	.0499	45	.0222	.00233	.00277	.00240	.0290	.0145
14	.0714	.00758	.0089	.0077	.0920	.0460	46	.0217	.00230	.00271	.00235	.0282	.0141
15	.0666	.00707	.0083	.0071	.0866	.0433	47	.0212	.00225	.00265	.00230	.0274	.0137
16	.0625	.00673	.0079	.0068	.0812	.0406	48	.0208	.00221	.00260	.00225	.0270	.0135
17	.0588	.00620	.0073	.0063	.0764	.0382	49	.0204	.00217	.00255	.00220	.0263	.0131
18	.0555	.00588	.0069	.0059	.0721	.0360	50	.0200	.00213	.00250	.00216	.0258	.0129
19	.0526	.00554	.0065	.0056	.0683	.0341	51	.0196	.00208	.00245	.00212	.0254	.0127
20	.0500	.00530	.0062	.0054	.0649	.0324	52	.0192	.00204	.00240	.00208	.0249	.01245
21	.0476	.00503	.0059	.0051	.0618	.0309	53	.0188	.00200	.00235	.00203	.0245	.01225
22	.0454	.0048	.0056	.0049	.0590	.0295	54	.0185	.00196	.00231	.00200	.02405	.01202
23	.0431	.00451	.0053	.0046	.0564	.0282	55	.0181	.00192	.00226	.00196	.0236	.0118
24	.0416	.00433	.0052	.0045	.0541	.0270	56	.0178	.00189	.00222	.00192	.0232	.0116
25	.0400	.00426	.0050	.0043	.0519	.0259	57	.0175	.00185	.00218	.00189	.0228	.0114
26	.0384	.00409	.0048	.0041	.0491	.0245	58	.0172	.00184	.00215	.00186	.0223	.01115
27	.0370	.00393	.0046	.0040	.0481	.0240	59	.0169	.00180	.00211	.00183	.02201	.0110
28	.0357	.00375	.0044	.0038	.0463	.0231	60	.0166	.00177	.00208	.00180	.02165	.01082
29	.0344	.00366	.0043	.0037	.0447	.0223	61	.0163	.00173	.00203	.00177	.02119	.01059
30	.0333	.00354	.0041	.0036	.0433	.0216	62	.0161	.00172	.00202	.00175	.02095	.01047
31	.0322	.00341	.0040	.0035	.0419	.0209	63	.0158	.00169	.00198	.00171	.02061	.01030
32	.0312	.00332	.0039	.0034	.0405	.0202	64	.0156	.00167	.00196	.00169	.02029	.01014

TABLE USED WHEN GRINDING FLATS ON THREAD TOOLS

the back trip of the feed rod the feed pin is thrown in. This brings the tool always in the same position when passing over the work. By feeding down 0.001 inch at a time after the tool has gone across, the teeth are formed in a 12-inch strip in about 18 minutes. Lard oil is used during the cutting operation. The strip is next divided in 8 equal parts cut off at an angle of 10 degrees.

A GRINDING FIXTURE

The single-point thread tool is now hardened all over in fish oil and drawn to a light straw color, then ground all over in the fixture shown in Fig. 2. This fixture is made of cast iron and used on the magnetic chuck. The first operation is grinding on the side, as shown at *A*. The thread tool lies with the T end resting against the shoulder of the block, and in a groove cut near one corner. The eccentric screws on top, one at each end of the work, keep it from shifting endwise when grinding, after the current is in the chuck. As will be noticed, two grooves are cut near the shoulders of the tool in order to leave a sharp corner after grinding. It is ground on each side to a sliding fit in the holder, but the T is not ground as it is finished when soft to go in its seat freely. The ratchet face is lapped a little to make it straight after hardening, then the tool is placed on the oblique surface of the same block, as shown in the end view *B*, and the side of the V ground to an angle of 30 degrees 23 minutes, the seat in which it rests being beveled to this angle.

The back of the tool is seated in the manner shown, and across the top is a strap held with a screw in each end. When the tool is turned over for grinding the other side of the cutting point, it is not necessary to bring the edge exactly in the center. Merely grind off until both sides are clean and to a sharp point. Care must be taken not to burn the point; use the whole face of a soft wheel and keep it free from dirt. The cutting face of the thread tool is ground on top to an angle of 10 degrees. For this operation it is held as shown at *C* in the same block. The groove is cut in the side of the block and in the strap at a 10-degree angle. The grooves are 0.010 inch larger than the slot in the thread tool holder, so when strapping the tool down it is drawn against the inside shoulder. Care must be taken also when grinding in this operation so as not to burn the tool point.

GRINDING THE FLAT ON THE TOOL

To facilitate grinding the correct width of flat for the single-point tool to cut United States Standard threads the accompanying table has been prepared. The distance from the point of the tool to the back is first measured with the micrometer, then the point of the tool may be ground off until the micrometer measurement from the back is equal to the whole depth minus dimension *A*, when we may be sure without undertaking the difficult job of measuring it directly that the flat *B* has the proper width. The dimensions *A* and *B* for pitches from 1 to 64 threads per inch are included in the table.

Set the tool with the ratchet face down in the magnetic chuck after the measurement over all has been taken with the micrometer as noted above; and use a very hard emery wheel. As the whole face of the wheel should be used for this purpose it must be dressed perfectly parallel with the chuck.

A CHASER FIXTURE

The single-point thread tools now being completed, the cutting chasers are ready to be cut on the face, which is also done in a shaper with the aid of a fixture shown in Fig. 3. A chaser will be noticed in place in the fixture jaws. The slide *a* is of tool steel, with a T-groove cut through the bottom, and made a snug sliding fit on the tool-steel base *b*. As it moves only 5/16 inch at the most, gibs were thought unnecessary. On the top slides the movable jaw *c*, which is likewise made of tool steel. The screw *d* is ⅜ inch diameter, and cut 20 threads per inch. The end is rounded and necked in, and the head thus formed works in a T-slot in the movable jaw. The screw is spring tempered and lapped to a good fit. The movable jaw *c*, which is made a sliding fit along slide *a*, is provided with two ribs on the bottom and held down with two screws and a piece *e* which is tapped out as indicated, to form a nut for feed screw *f*. This screw is also made of tool steel, and cut 20 threads per inch. Near the middle it is necked down to fit the bearing provided by base *b* and the large end is threaded to fit the nurled check nut *g*. Between the check nut and the bearing are placed disks *h* and *i*, and washer *j*, which goes next to the nut. On the outer end fits a short handle, shown at *i*, Fig. 4. Disk *i* is fastened to the base *b*, with two screws. Disk *h*, which is clamped by the nurled nut against the shoulder of the screw, is graduated in 50 divisions to read to thousandths of an inch. The base is clamped in a shaper, and the chaser is planed direct by a single-point thread tool; and in this way we get the flats with perfectly sharp corners and by turning the feed screw *f*, the pitch can be gotten accurately.

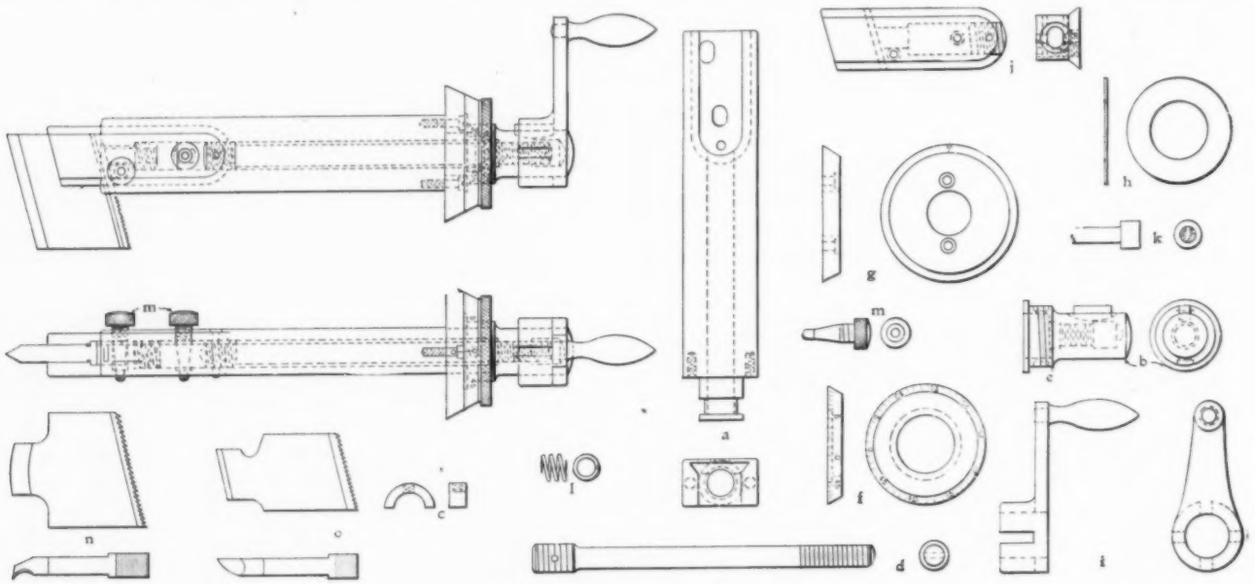


FIG. 4. THREAD TOOL HOLDER

ANOTHER THREAD TOOL HOLDER

Now to get the depth of a thread we have a special tool holder, shown in Fig. 4. This was designed to permit perfect setting of the tool after grinding, and to use single-pointed thread tools to cut chasers as well as screw plugs, taps, etc. This tool holder is used in a lathe as well as in a shaper. Most of the modern machines are supplied with micrometer dials

to read to 0.001 inch, which could be used for ordinary screw cutting, but for this class of work this fixture is safer. It is designed on the same principle as the other tool holder, shown in Fig. 1. The body *a* has a 5/16-inch hole drilled through, and at the rear end is turned to fit piece *b* and is necked in 3/32 inch, and ¼ inch wide to receive bushing *c*. This end is hardened and lapped. Bushing *c* is made of tool steel with a ⅛-inch tapped hole in each side to match the holes shown in *b*. A groove is filed in a little way at each end, and after it has been hardened and lapped to a fit in the bearing, and a driving fit for its seat in piece *b*, it is broken apart so it can be placed in position when the tool is assembled.

The piece *b* is bored to fit the hub formed on body *a* and threaded internally, twenty per inch to fit screw *d*. The outside is threaded at *e*. Part *b*, dials *f* and *g*, washer *h*, the nurled check nut, and the handle *i*, are assembled in the manner clearly shown. The holder *j* is a sliding fit in the dovetailed end of *a*, and has a ⅜-inch hole in one end which is tapped out to fit screw *d*, which when put in place, is secured with a pin. At the other end the hole is elongated to allow ratchet plug *k* to move up and down when setting the tool. At the front end of sliding holder *j*, is a T-shaped slot to fit the chasers after they are hardened and lapped. The spiral spring *l* pressing against the head of the plug forces the latter inward when the chaser is released. Through the side of the holder are two taper body screws *m*, which are adapted to slide in elongated holes in the body *a*. One of these screws tightens the chaser while the other adjusts it vertically to position. To place the toolholder in the tool-post, the taper screws *m* must be removed. When taking out the screw behind the plug, let a short piece of wire follow from the other side so the ratchet plug cannot go past the hole.

FINISHING THE CHASER

To plane the chaser is a very simple operation. Square up the tool-holder Fig. 4 in the tool-post, place the micrometer fixture Fig. 3 on two parallels in the shaper vise and clamp it securely. When the chaser is clamped in position take a light finishing cut on top with the shaving tool *n* Fig. 4. This precaution is taken to insure the top and bottom of the chaser being exactly parallel. The vise may be swiveled to give the chaser desired side clearance for the work it is to be used on, and the shape of the single-point tool may, of course, be modified to allow for this clearance, as well as for the front clearance of 10 degrees.*

The shaper vise being properly set it is a small matter to shape the thread. Place a side tool *o* in the holder shown in Fig. 4, and face off the cutting side, so that when completed the outer side of the first thread will always remain the same as the end is ground off. Care should be taken to have a full thread on the first tooth; this can be assured by starting right. Take a magnifying glass and see that the corner of the flat of the single-point thread tool is right on the corner of the chaser when starting. Now move the dials on the tool holder and fixture to zero and lock them with the nurled check-nuts. We have now a direct reading when feeding or moving for depth or pitch. Feed the single-point thread tool

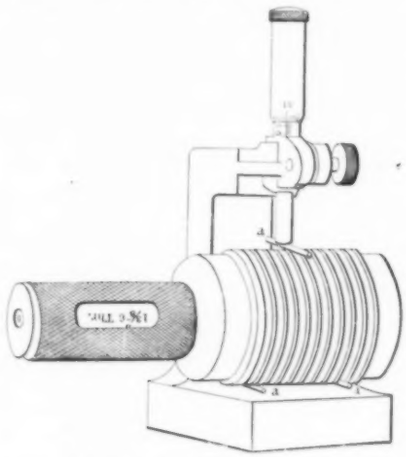


FIG. 5. DEVICE FOR MEASURING THREAD DIAMETERS

down 0.001 at a time until within 0.002 of finishing, the depth being taken from the table; when all threads are cut down in this way, start over again and finish with 0.0005 cuts. It is advisable to keep the tool well lubricated to insure a smooth thread on the chaser. A very good lubricant for this purpose is a mixture of one-half turpentine and one-half good lard oil. This will be found an excellent lubricant for general thread cutting in the lathe.

MEASURING THREAD DIAMETERS

Some take it for granted that if the measurement over the top of the threads and that at the root are correct the thread cannot help being a perfect fit, and no doubt they are right provided the root diameter is measured properly and the sides of the teeth are cut at exactly the right angle. The surest measurement, however, is obtained in the thread angles and this method, which involves the use of wires and micrometer, was described fully by W. Cantello, in the AMERICAN MACHINIST, at page 904, Vol. 26. It has since come into very common use. The measurements are accomplished by the aid of short pieces of round wires, different diameters being employed for various pitches of threads. Fig. 5 illustrates a neat fixture that is adapted to this work. Procure a micrometer screw head, and fit into the C-shaped body, which should be of tool steel, hardened and lapped at the anvil. The micrometer has a more exact and an easier adjustment than is secured by a movable anvil. This is obtained by turning down the barrel about 0.025 inch on a side, and placing over it a thin graduated sleeve. The sleeve is made a tight fit on the barrel and has a small hole drilled near its lower end, so that it may be turned by means of a small spanner wrench to compensate for wear or give an even starting point for setting. The fixture body is bored out at the top to fit the micrometer head, is slotted in front and fitted with a nurled screw to clamp the head securely. Great care should be taken when grinding the base after hardening, as the micrometer spindle must stand perpendicular to the base to insure accuracy. The wires are shown in position at *a a a*. It is not necessary to have this fixture as an ordinary micrometer may often answer, especially for measuring fine-pitch screws; but it can easily be seen that the fixture makes the job much easier to handle.

TAPS AND DIES

Some toolmakers when threading taps consider it good practice to give them a slight taper, making them smaller at the shank end; this prevents their binding when the cutting end becomes slightly worn, while the taper is not enough to affect the accuracy of the lead. Various forms of dies are used in cutting threads, but not all of them are arranged for grinding when they become worn. A round, adjustable die shown at *a* Fig. 6, has proven very satisfactory. It is held by shoulder pin *b*, and placed in an ordinary die holder with a center screw, and an ad-

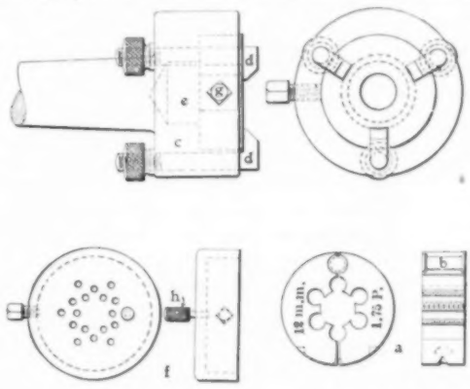


FIG. 6 TOOLS FOR MAKING DIES

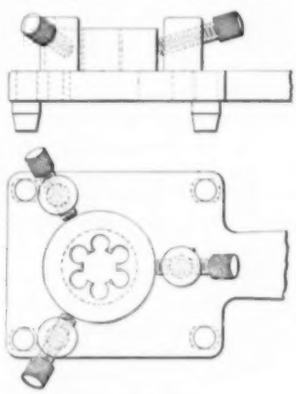


FIG. 7

*Methods for getting the thread-tool angle to allow for a given front clearance were published in AMERICAN MACHINIST for April 9, 1887.

justing screw on each side. It can be taken apart and all the lands ground on the face, making the cutting edges as good as new. As we had many different sizes, all of them the same outside diameter, it was considered advisable to make a holder *c* to receive the dies, while they were being faced to thickness and bored, chased, tapped, etc. It has a tapered shank to fit the tapered hole in the spindle of a lathe, the opposite end being bored out to receive the die as shown. A set screw is used to hold the die in place while it is being faced, and 3 clamp screws *d* are used when boring, chasing, tapping and chamfering the corners, etc. A clearance opening somewhat smaller than the one receiving the die is provided at *e*. The die is first turned to the desired diameter and left a trifle thick for finishing in this holder. One side is faced true and smooth; after, it is removed and reversed in the holder and the opposite side faced to thickness. It is then drilled and tapped.

A DIE-DRILLING JIG

The distance to the center of the clearance holes from the center of the die, must be in accordance with the practice in the shop where the work is done. It is practicable to lay them off after finding center by means of holder *f*, which accommodates different sizes. The die is held with a screw *g*, while center punched around on the same circle with the hardened, ground, and lapped punch *h*. After that operation the die is drilled in the jig Fig. 7. The hole is started with a No. 50 drill to a depth of about ⅛ inch, then drilled through with a ⅛-inch drill; after drilling the series of holes they are counterbored to the diameter required according to the size of the cutting die.

FINISHING THE DIE

Now draw a line through the center of two clearance holes, and lay the shoulder pin hole out close to the outer edge. Drill and ream a 3/16 hole through, and counterbore a 5/16 hole 1/16 inch deep on each side; in the opposite side is drilled a conical hole to receive a screw point to open the die with when in operation. On each side of the center, an end mill cut is made for the adjusting screws to bear against. The saw split should not be carried quite through, but should leave 1/32-inch stock to prevent the die springing when in the hardening bath. File a sharp groove on the outside to make it easier to break after hardening. Before hardening, run a finishing hob through the die to remove any burs or dirt there may be in the thread. Pack hardening provides an excellent method for hardening dies, for cutting threads, but if this method cannot be used, they should be very carefully heated in a tube, or some receptacle where they are protected from the fire. Extreme care should be exercised in heating; and the die should be immersed in a bath of lukewarm water or brine. After the temper is drawn the die is broken apart.

A UNIVERSAL SHRINK RULE

Compound as Well as All Simple Shrinkages Allowed For

BY F. W. BARROWS

The shrink rule is considered by most patternmakers to be a very necessary part of their outfit, and it is usually found that more than one is necessary. For instance, the most ordinary form is the well-known 24-inch boxwood rule, marked "24¼ inches to 2 feet." This "one-eighth" shrink rule is in pretty general use throughout the country, although some patterns for heavy work are made with as little as 1/12 of an inch shrink to the foot, and for several years, on certain classes of castings, I have allowed but 1/16 of an inch to the foot for gray iron.

It is commonly known that pieces of large size shrink more in hight than in width. That this is also true of small castings is very probable, although not so easily verified.

THE VARIETY OF SHRINKAGES

The amount of shrinkage allowed for gray iron thus ranges from 1/16 to 5/32 to the foot. The ordinary allowance for brass and malleable iron is 3/16, and for steel castings as much as ¼ has been allowed. Without citing any more examples, it will be seen that the patternmaker who proposes to equip himself with scales for all classes of work, will soon have so many on hand that he is likely to suffer in pocket, if not in reputation, by the selection of the wrong scale for some special job.

Another class of work, the making of masters for metal patterns, is likely to increase his collection by calling for double shrinkage, or a combination of shrinkages, as when a brass pattern is required from which an iron casting is to be made, or *vice versa*.

Shrink rules for allowing as much as ½-inch to the foot, are easily obtainable, and Keuffel & Esser list an assortment ranging from 1/10 to 1⅜ inches to the foot, although what this last one is used for I don't know, but presume that it has a use, else it wouldn't be listed.

COMPOUND SHRINKAGES

Suppose we are to make machine patterns (to be used on a molding machine) for a small brass valve body. The patterns are usually made of gray iron, while the casting for the valve is of steam metal. Here is a combination of shrinkages, 3/16 for the steam metal, ⅛ for the iron pattern, and the same for coreboxes.

Or, if we wish to make multiple boxes, the shrinkage gets more complicated, one method calling for white-metal patterns (for the corebox) which were cast over white-metal cores, and the cores, in turn, cast in an iron corebox.

This calls for (1) 3/16 shrinkage for the valve body, (2) ⅛ for the multiple box, (3 and 4) some unknown amount for the white-metal pattern and the core to cast it over, and (5) ⅛ for the iron box from which the white-metal cores are made.

Another way of producing the multiple boxes is from a brass pattern, made up of units, again cast from a brass pattern, cast in turn from a plaster-of-paris-pattern. Here, in making the plaster-of-paris master, a total of 11/16 to the foot must be allowed for shrinkage.

OTHER COMPLICATIONS

An item which is seldom allowed for in making master patterns, is the fractions of a foot which come into the calculation, as, in the last case cited, suppose some dimensions of the valve body to be one foot. The pattern or box to produce this dimension, in steam metal, should measure one foot and 3/16 of an inch, and the next shrinkage should be allowed on 12 3/16 inches instead of one foot. The brass pattern for the corebox would then measure a little more than 12 5/16. The units of which this pattern is made up would be something over 12½ inches, and the pattern for the unit would perhaps measure 12¾ instead of 12 11/16, as stated above.

Another error, which is more common than most patternmakers are willing to acknowledge, is the attempt to make some dimension not marked on the drawing, and which therefore has to be scaled, fall exactly on some division of the scale, thus, possibly, inculcating an error at the outset.

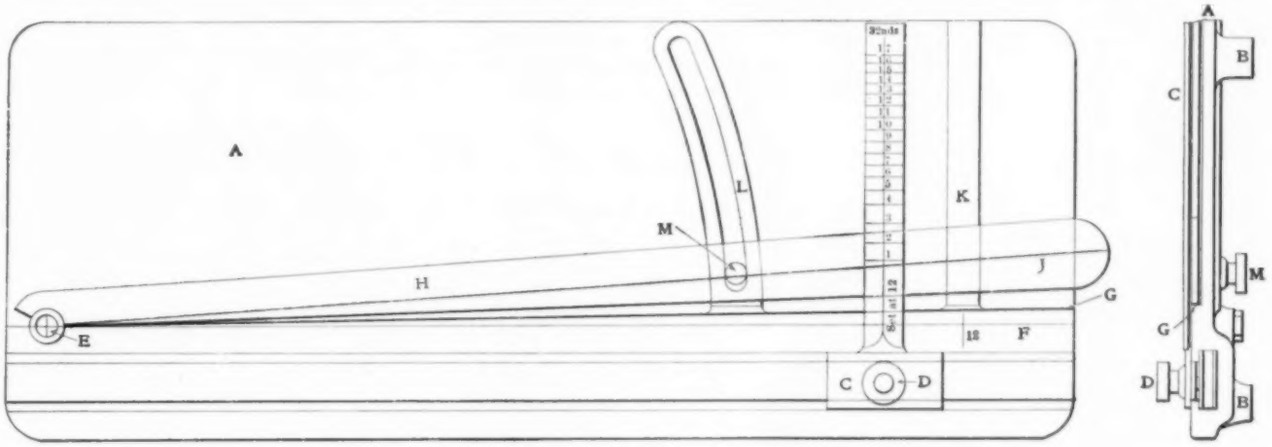
There is no doubt, to me at least, that one may make any measurement, up to the extreme length of the scale used, with the same limit of error. That is, one can, by using a two-foot scale, lay off 52 inches with the same accuracy as one inch, and any measurement up to 24 inches, which falls on some division line of the scale, may be taken with equal uncertainty.

FIGURING THE SHRINKAGE

If an attempt to *figure* the complicated shrinkage mentioned above is made, the resulting dimensions will be carried to such small parts of the inch that the ordinary scale is of no use. If this dimension could be fixed at once by two marks, one at each limit, without regard to the number of inches and parts of an inch contained in the space between, an ideal scale or gage for this dimension is at hand. Further, if this could be accomplished (within limits fixed by the size of instrument) for any dimension, a scale would be produced which would always have the two limiting lines exactly where needed,

and would *not* have other lines to cause confusion. To make this point still plainer, suppose a measurement of 6 47/64 inches, is to be made, which would be preferred, an ordinary steel scale graduated in 64ths, or the same piece of steel with but two lines on it, 6 47/64 inches apart? Wouldn't the scale with but two lines be the one to use?

If it was afterward necessary to allow for shrinkage on this dimension, at the rate of 11/16 to the foot, it is very probable that we would not have a shrink rule for this allowance; but if the two-line scale had been made in the form of a right-angled triangle, the base of which measured 6 47/64, while the hypotenuse was as much longer as the required shrinkage made necessary, we would have a scale by which these two measurements could be made with the least possible chance of error.



A UNIVERSAL SHRINK RULE

If the base of this triangle was adjustable as to length, other measurements, allowing for the same rate of shrinkage, could be taken from the hypotenuse, and if the angle opposite the perpendicular was also adjustable, other rates of shrinkage could be obtained with equal accuracy.

THE NEW SHRINK RULE DESCRIBED

How this may be accomplished, and still retain the desirable features of the two-line scale, I will try to explain.

In the illustration *A* is a cast-iron plate, having a T-slot along one edge, and supported by four legs as shown in end section at *B B*. This plate was finished to a smooth surface, and the T-slot was cut out of the solid. The slide *C* was then fitted to move smoothly and without shake, in the slot, and was held down by a flat spring, bearing under the shoulders of slot, and the clamp-screw *D*. By means of this screw the sliding arm, or indicator, *C*, can be firmly fixed at any required point; but it was found that, when in use, the tension of the flat spring could be so regulated that it was unnecessary to operate the thumbscrew at each new setting of the slide.

The slide has both edges finished perpendicular to slot. The arm of *C* is 1/16 thick on the center line, but beveled down to 1/64 at the edges, which were hardened. At *E* a countersunk plug was fitted, held down by a small nut and keyed by a pin. Draw the base line *E F* parallel with the slot and crossing the center of plug *E*. Mark a point on this line by another short line square with the first line and crossing the plug at the center, which plug is then to be hardened and replaced in the plate.

The slide *C* is next placed in position, and adjusted with one of its edges exactly 12 inches from the point marked by the intersection of the two lines across the face of plug *E*, and a line scribed along its edge to the shoulder *G*, thus fixing a point at 12 inches from the center of plug *E*.

The swinging arm *H* is hinged on plug *E*. This arm has on its surface, the radial line *E J*, and it is supported by the surface of the bed at *K* and *L*, and is fixed in any desired position by a clamp screw under *M*.

GRADUATING THE INSTRUMENT

To graduate arm *C* set at 12 inches, the right edge being indicated by the lettering. Set a pair of trams to 12 1/32 inches, and with one point in the center of plug *E*, the other point being placed in the line *E J*, swing arm *H* away from base line *E F* until the point of the tram resting in line *E J*, touches the edge of arm *C;* tighten screw *M*, and we have the instrument set for a shrinkage of 1/32 inch per foot.

A line is now squared across *C* at the point where the line *E J* intersects the edge of *C* marked *set at 12*. Take another measurement, 12 1/16 inches, with the trams, and go through the same operations as before. Continue these measurements, using every thirty-second inch up to ½ inch, and we have the arm *C* graduated for any shrinkage up to ½ inch, by thirty-seconds.

Any other desired shrinkage, within the limits of the instrument, may be obtained in the same way. With the one shown in the cut, shrinkage at the rate of 1⅛ inches to the foot may be allowed on any measurement up to 9 inches.

The marks on *C* may be interpreted:

32ds when set at 12 inches.

It will be seen that this instrument has all of the good points sought for, viz.:

(1) A base line *E F*, upon which the desired dimension may be located by center of plug *E* and edge of arm *C*.

(2) A second line *E J*, upon which, after suitable adjustment of *H*, the correct dimension, with predetermined rate of shrinkage added, is fixed by the same extremes, one of these *E* being a fixed point, and the other *C* being set when the measurement on the base line is made.

Reset the instrument for 1/32 shrinkage, then any measurement made on base line *E F*, and located by *C*, may be instantly taken from *E J*, that portion of *E J* between *E* and *C* being equal to the base *E F*, with the 1/32 per foot shrinkage added, and until the arm *H* is moved, all measurements made on line *E F* being repeated on *E J* with this rate of shrinkage added.

For one who wishes to allow for the shrinkage on the fractions of a foot, referred to when speaking of multiple core-boxes, this instrument may be adjusted to his satisfaction, in the following manner.

USE FOR COMPOUND SHRINKAGE

With *E J* set for ⅛ shrinkage, set *C* at 12 3/16 inches on the base line, take the length of *E J* with trams, then, after adjusting *H* for 3/16 shrinkage, set *C* by trams on base line and again set the trams by *E J* and readjust *C* to this last measurement, transferred to *E F*. Finally, with trams once more set to the last length of *E J*, and *C* set at 12, with one point of the trams in center *E*, the other resting in line *E J*, swing arm *H* until the point comes against *C*, then clamp *H* and we have the instrument set for the four-fold shrinkage to be allowed for.

It is evident that after once fixing the position of the line *E J*, any measurement within the capacity of the instrument may

be made by moving *C* to the desired point. Also, as both edges of *C* are perpendicular to the base line *E F*, that either edge may be used to measure from, which is a desirable feature, for, while the edge toward *E* will be most convenient for dividers or inside calipers, the farther edge will certanly be the best for outside calipers.

In using this instrument, the first requisite is an accurate, full sized drawing of the piece to be made. The pattern-maker has long been accustomed to the privilege (and also the responsibility) of making this drawing, and greatly to his credit, it may be said that he is entirely competent to do this.

All dimensions are to be taken from this drawing with dividers or calipers, as may be most convenient, transferred to base line of the instrument, which has previously been adjusted for the desired shrinkage, and then the dimension for the pattern may be taken from the hypotenuse *E J* using the dividers or calipers.

Don't use a scale with this instrument.

ERRORS IN AND LIMITS OF WORKMANSHIP

Two Comprehensive Reports of the British Engineering Standards Committee

At various times in the past we have referred to the great work of the British Engineering Standards Committee and, in particular, at page 254 we referred at some length to their report on Limit Gages for Running Fits. Taken in connection with the report on Errors in Workmanship, which is anticipatory to it, there is much of interest and value in this report, and we reproduce herewith some of the more interesting of the committee's conclusions.*

BASIS OF WORK

The report on Errors in Workmanship is based on accurate measurements of a great variety of pieces produced at various shops, the exact measurements being compared with both the nominal and the intended, that is the nominal plus or minus the allowance for fitting, dimensions, the comparison thus disclosing both the intended allowances for fitting and the errors of the workman in obtaining the intended dimensions. The measurements were made both for shafts and holes and thus show the errors in both turned and bored work. Pieces were measured from thirteen different shops, the total number of pieces measured of which full particulars are given aggregating 534 and ranging from ½ to 20 inches in diameter.

DIFFERENCES BETWEEN BRITISH AND AMERICAN PRACTICE

The first table of the report gives the practice of the various firms in the matter of allowances and tolerances† from which it appears that for running fits six always or usually make the allowance in the hole, two make it in the shaft, four divide their practice and of one the practice is not stated. For force fits three make the allowance in the hole and three in the shaft, while of seven the practice is not stated. But three regularly allow a tolerance, three sometimes allow it and seven never do. To one accustomed to American methods it seems strange that for any work of reamer size the allowance should ever be made in the hole and we note with surprise that "for running fits the committee are of opinion that wherever possible the shaft should be the element more nearly approaching the true dimension and allowance be made on the hole according to the class of fit required."

THE USE OF THE REAMER IGNORED

A strange feature of the report is the neglect to specify the method of finishing the holes. In the larger sizes it is certain that this was done with a boring tool, while in the small ones it is equally certain that some were finished with a reamer, and a marked difference in accuracy would be expected with the difference in the method followed, but, nevertheless, we find no distinction drawn. A classification is made for work manufactured to limits, but this does not help us out, as much of this is of a size which precludes the use of reamers, whereas in the smaller sizes it is just the class in which we should expect reamers to be in large use.

GRAPHIC REPRESENTATION OF THE MEASUREMENTS

In Figs. 1 and 2 we have reduced to diagrammatic form the average of the observations on several classes of work. The diagram gives the errors from the intended—not the nominal—sizes, the classes of work being indicated by the character of the lines which join the points giving the averages of the observations. There is no line for ground holes because the number of such holes examined was too small to permit of generalization. The figures against the observation points give the numbers of pieces of which the recorded points give the average errors.

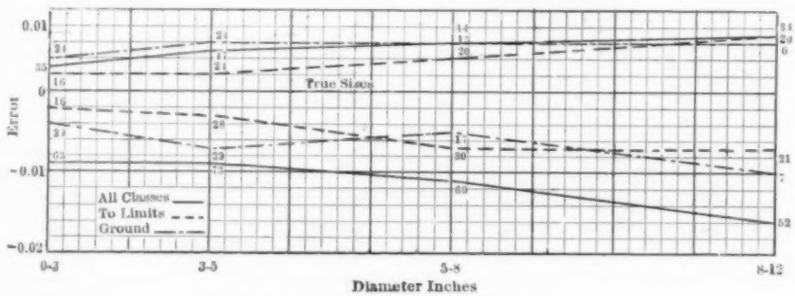


FIG. 1. AVERAGE ERRORS—SHAFTS

Several things are conspicuous in these diagrams: (1) The general increase in the error with the diameter of the work; (2) the markedly better results for work done between limits; (3) the tendency to make the shafts too small and the holes too large, in interpreting which we must remember that the allowances for running fits do not enter the diagrams which give the variations from the intended sizes after the character of the fit has been allowed for. This tendency is quite as marked when considered with reference to the number of pieces as when the magnitude of the errors is considered. Table 1 gives the number and percentage of pieces found to be large and small respectively. One thing which we would

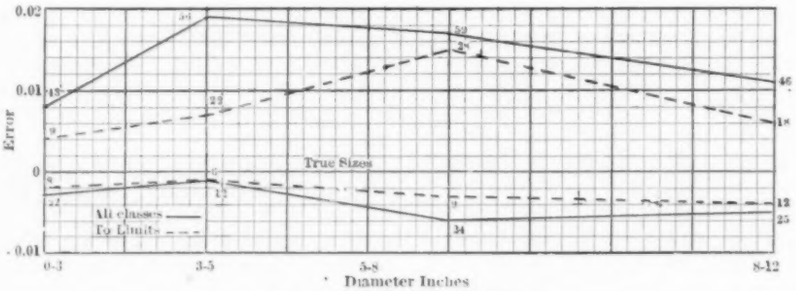


FIG. 2. AVERAGE ERRORS—HOLES

*The report on Errors in Workmanship is quite voluminous, comprising sixteen 8x13-inch pages, with 12 double-page tables and 14 full and double-page plates. The report on Limit Gages is smaller, containing 10 pages with several full-page and one double-page plate. The price of the former is 10 shillings 6 pence and of the latter 2 shillings 6 pence. They may be obtained of the D. Van Nostrand Company, of this city.

† The committee defines *allowance* as "a difference in dimensions prescribed in order to allow of various qualities of fit" and *tolerance* as "a difference in dimensions prescribed in order to tolerate unavoidable imperfections of workmanship."

expect to find is conspicuously absent—superiority of ground over turned shafts. The ground shafts are distinctly inferior to those turned to limits and not markedly superior to the average of all shafts.

A SYSTEM OF ALLOWANCES AND TOLERANCES

As has been remarked, the committee recommend that the variation (allowance) for various qualities of fit be made in the holes and as a result of their labors they give, in the report on Limit Gages for Run-

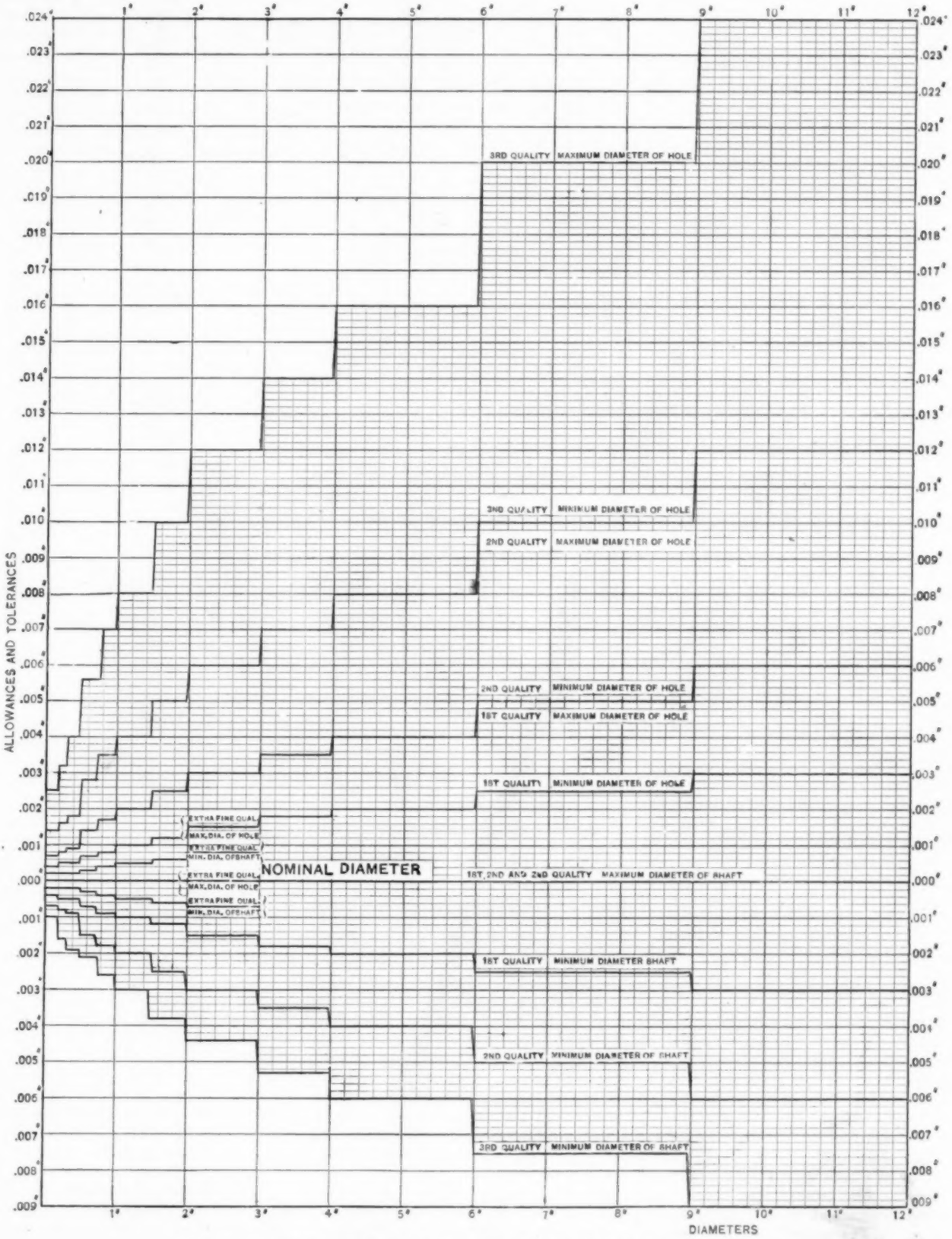

ALLOWANCES AND TOLERANCES
DIAMETERS
NOMINAL DIAMETER
3RD QUALITY MAXIMUM DIAMETER OF HOLE
2ND QUALITY MINIMUM DIAMETER OF HOLE
2ND QUALITY MAXIMUM DIAMETER OF HOLE
2ND QUALITY MINIMUM DIAMETER OF HOLE
1ST QUALITY MAXIMUM DIAMETER OF HOLE
1ST QUALITY MINIMUM DIAMETER OF HOLE
EXTRA FINE QUAL. MAX. DIA. OF HOLE
EXTRA FINE QUAL. MIN. DIA. OF SHAFT
EXTRA FINE QUAL. MAX. DIA. OF HOLE
EXTRA FINE QUAL. MIN. DIA. OF SHAFT
1ST, 2ND AND 2ND QUALITY MAXIMUM DIAMETER OF SHAFT
1ST QUALITY MINIMUM DIAMETER SHAFT
2ND QUALITY MINIMUM DIAMETER OF SHAFT
3RD QUALITY MINIMUM DIAMETER OF SHAFT

FIG. 3. BRITISH STANDARD TOLERANCES AND ALLOWANCES FOR RUNNING FITS

ning Fits, a recommended system of limits which we reproduce in Fig. 3. They recommend four grades of workmanship, called respectively 1st, 2d and 3d quality and extra fine quality work, the latter extending to 3 inches diameter only while the others are extended to 12 inches. The system provides that the maximum diameter of the shaft shall never exceed its nominal diameter, the nominal diameter being always the upper limit of size. The tolerances for shafts are thus always negative. On the other hand the hole is always larger than its nominal size, at the lower limit by the allowance and at the upper limit by the allowance plus the tolerance. That is to say, in the case of a 5-inch shaft and hole of the first class, the tolerance on the shaft is 0.002 inch; the maximum diameter of the shaft is 5 inches, and the minimum will, therefore, be 4.998 inches. The allowance being 0.002 inch the minimum diameter of the hole is 5.002 inches. The tolerance on the hole is 0.002 inch, giving a maximum diameter of the hole of 5.004 inches.

The committee call this system the *shaft basis system*, the opposite being the *hole basis system*, and they point out that when the hole basis system is used "the tolerances specified for shafts and holes respectively may still be employed and the standard allowance applied to the shaft instead of to the hole, the minimum diameter of the hole being accurately its nominal size."

		Shafts.				Holes.			
		Total.	Large.	Small.	Correct.	Total.	Large.	Small.	Correct.
All Classes.	Number of Specimens.	456	160	257	39	329	204	83	42
	Percentage.	100	35	56	9	100	62	25	13
To Limits.	Number of Specimens.	196	80	95	21	129	77	35	17
	Percentage.	100	41	48	11	100	60	27	13
Ground.	Number of Specimens.	174	67	82	25				
	Percentage.	100	39	47	14				

TABLE 1. LARGE AND SMALL PIECES.

A comparison of the two systems for a 5-inch shaft and hole is given in Table 2.

The hole basis system being in common use in this country, the committee's recommendations can only be used here when modified as above, but that need not prevent full advantage being taken of their exhaustive inquiry.

Dimension.	Shaft Basis. In.	Hole Basis. In.
Max. Diam. Shaft.....	5.000	4.998
Min. Diam. Shaft.....	4.998	4.996
Max. Diam. Hole.....	5.004	5.002
Min. Diam. Hole.	5.002	5.000

TABLE 2. COMPARISON OF SHAFT AND HOLE BASIS SYSTEMS.

These very brief extracts from these reports will make plain to our readers the thorough-going and painstaking character of the work of the committee.

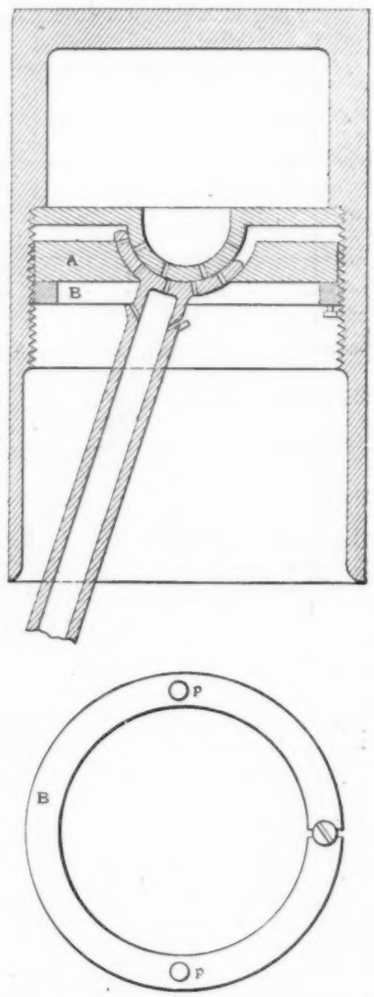
We may add that among the instructive tables and diagrams which are not reproduced here are those showing the percentage of the work examined, and classified for this purpose, which falls within the limits supplied by Mr. Matthews, of Sir W. G. Armstrong Whitworth and Company. Inasmuch as this system of limits differs from the one finally recommended by the committee we have not thought it necessary to reproduce these tables or diagrams.

The Bearing at the Piston End of the Connecting Rod of the Dock Internal Combustion Engine

An interesting feature of this engine, which is made by the New York Safety Steam Power Company, 114 Liberty street, New York, is the connection between the piston and the connecting-rod. This is shown in the illustration.

No wrist pin or gudgeon pin is employed. A thrust plate having a hollow half-ball formed in its center is screwed into the intermediate counterbore of the piston; the upper end of the connecting rod is formed into a hemispherical cup ground to fit the under side of the half-ball and is held against this half-ball by the plate *A*, through the center of which is an opening ground to fit against the back of the cup on the connecting rod. This last mentioned plate fits snugly within the piston counterbore, but is not screwed in; it is backed up by a ring *B*, which screws into the counterbore. This ring is split at one point and a tapered screw is fitted at the split so as to expand the ring when set up; this is shown in the plan view below the view of the piston, where are also shown two pins, *p p*, set into the face of the ring. These are to give a finger grip on the ring for screwing it into the piston counterbore, no tool being used for this purpose. When the ring is screwed up "home," the screw in the split is set up, expanding the ring in the screw threads. This construction obviously allows the piston to rotate within the cylinder and thereby prevent uneven wear; in practice the follower plate *A* is set up so lightly that the piston may be rotated freely by grasping the lower edge between the thumb and fore-finger and giving it a twist.

The oil for lubricating the ball-and-cup bearing and the crank-pin is taken from the interior of the cylinder and introduced into the chamber formed in the upper part of the piston by means of a collecting groove around the piston below the packing rings and a number of holes drilled through the piston wall at the bottom of this groove. Once within the piston chamber, the oil flows to the pocket in the center of the thrust-plate and thence it passes to the rubbing surfaces through holes drilled through the half-ball and cup. It also passes to the bore of the connecting-rod through the central duct in the cup; whatever oil may get out of the ball-and-cup joint and trickle down the outside of the connecting-rod is caught by a cup-shaped collar on the rod and con-



BEARING AT PISTON END OF CONNECTING-ROD

veyed to the interior of the rod by drain holes, as shown. The connecting-rod is a hammered-steel tube, imported from Germany. The ball-and-cup bearing at its upper end is of bronze and hardened tool steel, ground to a fit.

FOREIGN MARKETS FOR AMERICAN MANUFACTURES

Some Results of Higher Import Duties in Germany—A Comparison of British and Continental Wages—German Exports—Machinery Needed in South America, Italy and Japan.

There has been a large increase in the number and extent of strikes and lockouts in German manufactories during the last year or 18 months. The higher import duties on food stuffs has led to an increase in the cost of living all round; and consequently the operatives have agitated for higher wages to enable them to meet the additional cost. I am not expressing any opinion as to the merits of the extra duties; but I want to call attention to the fact that the wage bill in German factories has a decided tendency to rise, without a proportionate increase in the ouput.

INCREASE IN COST OF GERMAN PRODUCTS

It is openly stated in Germany that a permanent increase in cost of production in German manufactures will be the result, and that the policy which has led to this result will undermine Germany's position in the world's market, even if it has to a great extent safeguarded her home market. The United States is ever becoming a better customer to Germany, while admittedly in several branches there are complaints concerning the exports to Great Britain. The prices in the British market do not at present encourage German export; while it is contended that the increased cost of German production is already being felt by the export firms.

ADVANTAGES OF MANUFACTURING IN GREAT BRITAIN

British manufacturers can in many instances procure raw material and half-finished goods more cheaply than the German competitor, and several German manufacturers in the paper trade contemplate the establishment of branch factories in the United Kingdom. In German industrial circles the view is not seldom expressed that the German customs tariff has been overdone, and that every day brings fresh proof that British industry now has the advantage over the German. It is an oft-repeated argument that the British workman enjoys the cheaper food and the British manufacturer the cheaper raw material, and that in view of these facts alone the competitive capacity must be affected. Even if the change be not sudden German manufacturers expect it in the end, and they are beginning already to take it into account.

WAGES IN GREAT BRITAIN, FRANCE AND GERMANY.

It has been possible to ascertain the wages paid in three factories producing the same class or variety of fine machinery, one factory being situated in the United Kingdom, one in France, and one in central Germany. The factories are under the same head management, and produce in many cases machines of identically the same construction and for doing so have identically the same machine tools, special tools, patterns and other outfits:

	Wages Per Hour.		
	U. K.	France.	Germany.
	d.	d.	d.
Bench hands	7.55	7.91	5.82
Milling machine hands	8.00	7.72	5.65
Lathe hands	7.77	7.53	6.65
Setting-up hands	7.55	9.40	6.34
Tool makers'	10.00	9.40	6.21
Unskilled laborers	4.44	5.84	4.70

MACHINERY EXPORTED FROM GERMANY

The following table gives the total value of German exported machinery:

	1905.	1904.	1903.
	£	£	£
Locomotives	303,000	290,000	259,000
Tube boilers	64,000	55,000	41,000
Mounted sewing machines	92,000	84,000	81,000
Agricultural machinery	145,000	135,000	144,000
Brewery machinery	32,000	33,000	25,000
Milling machinery	88,000	81,000	71,000
Electrical machinery	142,000	134,000	135,000
Weaving machinery	85,000	74,000	80,000
Steam engines	246,000	240,000	224,000
Machine tools	292,000	235,000	204,000
Turbines	26,000	22,000	19,000
Pumps	104,000	90,000	84,000
Other machines	848,000	731,000	631,000

BOILERS, ETC., FOR ARGENTINA

In consequence of the rapid development of all industries in Argentina, as well as of navigation, there is an excellent demand for boilers of all sizes and types. British makers are doing well in this market, and there is no reason why United States exporters should not do likewise. The trade in portable railways of the "Decauville" type, which formerly existed, is now almost dead. The business, which can well be considered of some importance, is now in the hands of the German house of Koppel, who monopolizes the trade by offering better terms. There has been a good deal of activity in the railway-supply branch of trade in the republic. During the first nine months of 1905 no less than £3,000,000 worth of railway material was imported, including 183 electric tramways of German and United States origin. Most of the plant has hitherto been supplied by Great Britain, because the lines are owned by English capital, but the state railways have adopted German locomotives on their lines.

WIND MOTORS

There is a steady demand in Argentina for American made wind motors. In consequence of the general scarcity of waterways in parts of the republic there is a constant demand there for pumps and windmills. There are some firms in Buenos Ayres who do nothing else but fit up these plants. Lately some French makers have tried to get into the trade of supplying wind motors, but their products are found to be too heavy and too expensive. At present American makers have the control of the market.

ROPE-MAKING MACHINERY IN JAPAN

There is an opening now for rope-making machinery in Tokyo, and some other Japanese cites. The Tsukishima Rope-Making Company, of Tokyo, is very largely increasing its capital to enable it to meet the increase in its business, and the example is being followed by other concerns of the kind. They will be wanting new plants and it would be well for makers in the United States to get into touch with all the rope-making companies in Japan. The import duty has recently been heavily increased until it now stands at the prohibitive rate of 6 yen. The value of the wire rope imported in 1905 was 403,000 yen.

RAILROAD PLANT IN ITALY

The Italian Government is proposing to spend twenty million dollars, in improving the rolling stock, etc., of the state lines, which will be improved, the railway stations repaired and enlarged and new tools, rolling stock and general railroad plant added. The tenders will probably be open to foreigners, and provided they can quote 10 to 75 per cent. below Italian prices, the business will be placed with such foreign bidders.

WIRE FENCING WANTED

The farmers of Sucre (Bolivia) are feeling the necessity of fencing in their ranches, which are extensive, in order to reduce to a minimum the straying and stealing of immature or unmarked cattle. What they require is something cheap, but durable, which will fairly resist organized attempts at destruction, and be equally useful over level country, and broken ground, which the boundaries traverse. It is possible that posts will not be wanted in view of the fact that there is in the country an abundance of ironwood and other timbers which will resist pretty nearly anything as well as galvanized cast iron; but, of course, tenders might include posts, which, in some cases, at least, will no doubt be wanted. F. C. C.

London, England.

When American machinery manufacturers feel the need of foreign markets they will go into them effectually. Until then they will do little.

A 32-SPINDLE RING DRILLING MACHINE

BY HUGH DOLNAR

The Couple-Gear Freight-Wheel Company, Grand Rapids, Michigan, controls the use of Holson's live wheels in vehicles, and is building 5 tons paying load trucks, all four wheels independently driven. The electric motors are carried in the truck wheels themselves, all four wheels the same and requiring good machine work. Ring drilling and motor-frame milling processes are peculiarly carried out in the couple-gear factory, under the direction of Mr. Karsten Knudsen, who is a mechanical engineer and electrician and designed the couple-gear truck, and the 32-spindle driller here shown.

The drilling problem was to find the best and cheapest way to drill two circles of holes in welded steel rings, rough, ½ inch thick by 30⅛ inches outside diameter, and 26⅝ inches inside diameter. Eight of these rings are required for each truck, and the holes must be located with little error. The inside circle has 32 holes, and the outside circle, of only ⅜ or ½ inch larger diameter, has 16 holes, all equal spacing.

To drill these rough, flat rings Mr. Knudsen first locates the rings by an expanding device which brings the center of the rough inside diameter to the center of the drill spindle circles, then clamps a jig ring with 48 drill bushes in it on the work, pinching it to the fixture top surface, and provides 32 drill spindles, 16 in each circle, and drills the 16 outer circle holes at one operation with 16 spindles, and the 32 holes in the inside circle in two operations, with 16 spindles, turning the fixture round to drill the second 16 holes midway between the first 16 inner circle holes.

The half-tone and construction drawing show this novel driller pretty well. Several automobiles require rings of holes, and this ring driller is of much interest.

The driller drive is by one open and one crossed belt to one countershaft, the belts driving bevel pinions meshing with an integral bevel and spur gear, the single spur gear driving the whole 32 spindles, the 16 inside spindles a little faster than the 16 outside spindles.

The feed is underneath the fixture, all the spindle journals being stationary, the feed action being a screw on the table shank which takes a revolving nut driven either by the hand crank at the right or by the worm in front, power driven and engaging the worm gear which carries the table screw nut. The feed-worm shaft is belted down from the left pinion shaft, and is in a trunnion journal so as to swing out of engagement with the worm gear for the knock-off, or for hand moving of the table.

The oiling is by a two-pinion force-pump to a central overhead delivery and two power-driven oil tubes which turn round slowly and oil the drills in double sequence. The oil pump is driven from a pulley on the work shaft, the vertical belt permitting the swinging of the worm shaft.

The rings are drilled one circle of holes at one setting, as putting in and taking out drills would take too much time. The expanding ring-locating linkage is accurate in action, and locates the rings twice alike, points marked.

The half-tone shows the jig up and table down, ready to take a ring for drilling, with the jig-clamping hinged screws turned down.

The framing is simple, cheap and massive, very easy to machine, and it will be a good exercise to try to cheapen the design of Mr. Knudsen's 32-spindle driller.

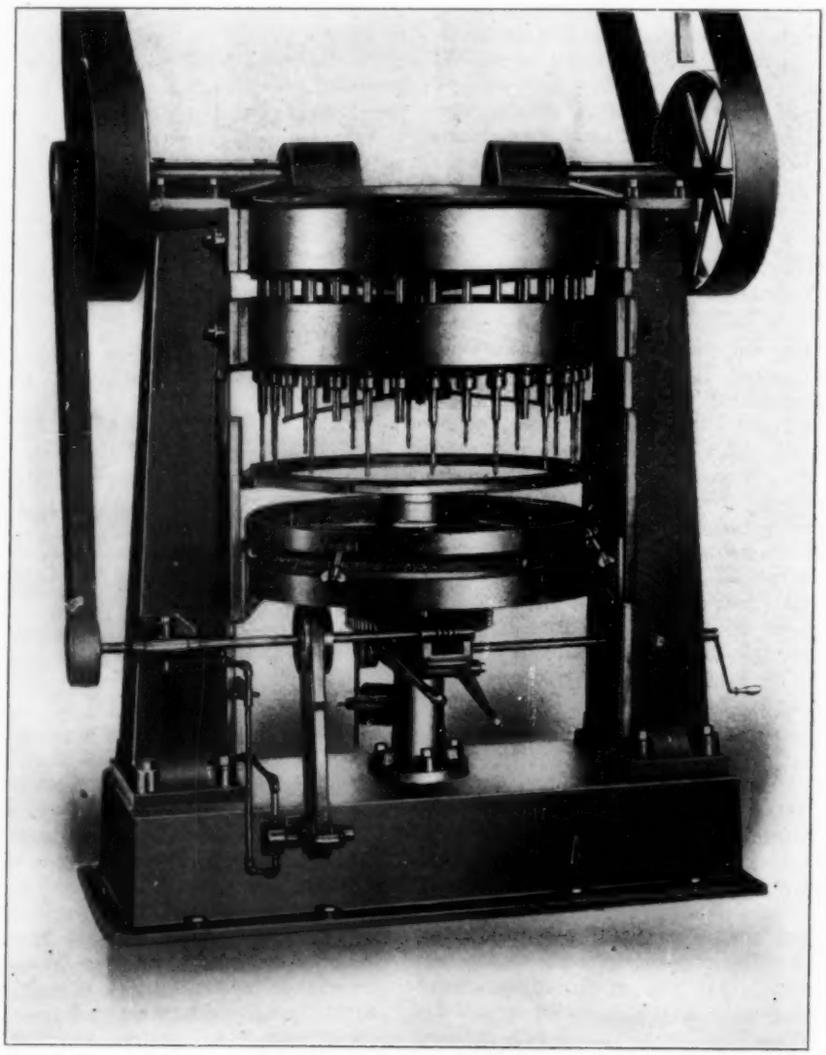


FIG. I. THIRTY-TWO SPINDLE DRILLING MACHINE

Legal Notes

BY E. P. BUFFET

LIBEL AGAINST MANUFACTURED GOODS

No doubt there are few machinery manufacturers who do not in the course of their business have frequent occasion for annoyance at statements made by their competitors in disparagement of the products of their shops. The question may arise whether there is any redress at law for such aspersions. A case in point has just been reported from the U. S. Circuit Court of Appeals, eighth circuit. A libel had been charged, resting upon the following letter alleged to have been written by a seller of safes, referring to varieties of safes of a make other than what he handled.

"Dear Sir: We have heard that you had placed order for a——screw door. We are somewhat surprised at this and feel that you have been misled. The ——plate safe is very cheaply con-

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structed and can be easily burglarized. The——, so called, manganese-steel safe is weaker still, and can be opened inside of a vault or anywhere else in a few moments' time. The large second-hand fire- and burglar-proof safe on which we made you a low price will stand much more explosive and is a much more difficult safe to open than any——you could buy. We are ready to demonstrate this at any time. We trust you have not concluded the contract, and will consider a proposition on our safe."

Now, in determining the actionability of libels, beside considering the questions of truth, malice, privilege, etc., a distinction is made between two classes, those belonging to one of which are sufficient ground for damages even though no actual injury from them be proved to have resulted; while to recover for the other class some real loss suffered must be shown. The former class covers personal defamation, of certain kinds at least, and also such statements as tend to injure one in his particular trade or profession. Strange as it may seem, the court does not hold the kind of libel here charged to belong to this latter class, but to the former one, where special damages would have to be set forth before the suit could be entertained. This is a fine distinction, resting on the direction of the aspersion against the safe manufacturer's property rather than against himself.

It would appear, then, that if a man falsely calls you a poor machinist you may soak him for damages, but if he says that the machines you have built are poor ones he is safe unless you can prove that you have lost a customer by it. This, however, may be going beyond the meaning of the court, which, it is hardly to be supposed, would be entirely controlled by the indirection of language as against an inanimate object, if a personal imputation was necessarily involved therein.

At any rate, the charge may imply something so wrong on the part of the manufacturer as to overcome the distinction. The court points out in this case that, even if the safes were, as alleged, cheaply constructed and were not designed to be burglar proof or difficult of opening, there was not necessarily anything immoral or reprehensible in their manufacture. They might still be useful and salable for protection against fire, or for other purposes. Otherwise are cases where language is held actionable without special damage when it imputes to a master mariner and shipowner a purpose to sail to a distant port with passengers and freight when his ship is so unseaworthy as immediately to endanger all on board; or where commodities are alleged to contain ingredients dangerous to health.

147 Fed. Rep., 211.

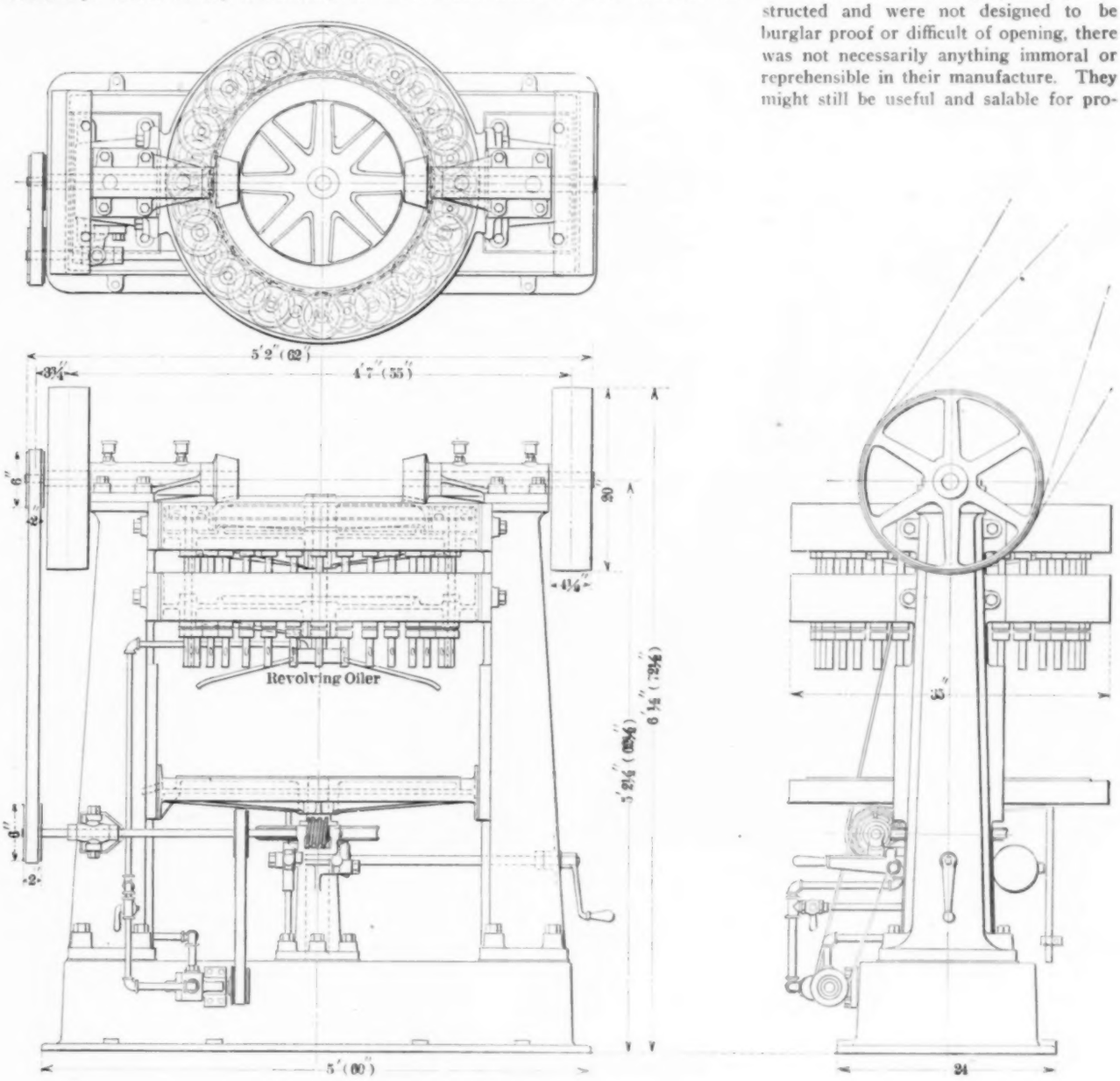


FIG. 2. THIRTY-TWO SPINDLE DRILLING MACHINE

A BORING AND DRILLING JIG AND ITS OPERATIONS

BY H. F. NOYES

The piece to be bored is illustrated in the drawing, Fig. 1, the jig and its details in Figs. 2 and 3, and the work in progress in the half tones, the work being also shown in dotted lines in Fig. 2.

As the work was to be done on a horizontal boring mill, a machine which is not as handy as a drill press for small drilling, the smaller holes were omitted, and the jig was designed for the larger ones, boring the 1⅞-inch hole *x*, and facing the ends, boring and facing the 1-inch hole *y*, boring and facing the 1⅛-inch hole *z*, and turning the outside diameter to 1¾ inch with the special head, Fig. 3.

The jig body comprises a strongly webbed plate provided with heavy vertically projecting lugs adapted to receive the drill and boring-bar bushings.

The work, which has been previously planed to dimensions, is located in place by a finished lip on the base of the jig, and by a set screw, the latter being adjustable to allow for variations in the casting; and is fastened in position by two small set screws; and then firmly clamped at the top, as shown in the half tones.

The jig body is provided with a tongue by means of which it is located on the swiveling table of a horizontal boring machine. The first operation is to rough drill the hole *y* with a 15/16-inch drill in the bushing at *D*. The table is then turned 90 degrees and the hole *x* is roughed out with the 1¾-inch roughing drill in the bushing at *E*. This bushing is then taken out and replaced by a cast-iron bushing for a 1½-inch boring bar, and the drill is replaced by the bar, which is first fitted with a 1 13/16-inch roughing cutter, and then with two finishing cutters, one being 1.765 and the last being 1⅞ inch. After the hole is finished, the bar is fitted with a right- and then a left-hand facing cutter, and each end faced off, the inner face of the hole being located with relation to the center of the hole *z* by means of a swinging gage *S*, and the length of the bearing by a caliper gage *T*, both of which are shown in detail in Fig. 2.

For the next operation the table is again turned 90 degrees, bringing the hole *z* toward the head of the boring mill. The hole *y* is then finished by boring with cutters in a ⅞-inch bar, suitable bushings having been previously placed at *C*, using first a roughing cutter 0.990 inch, and then

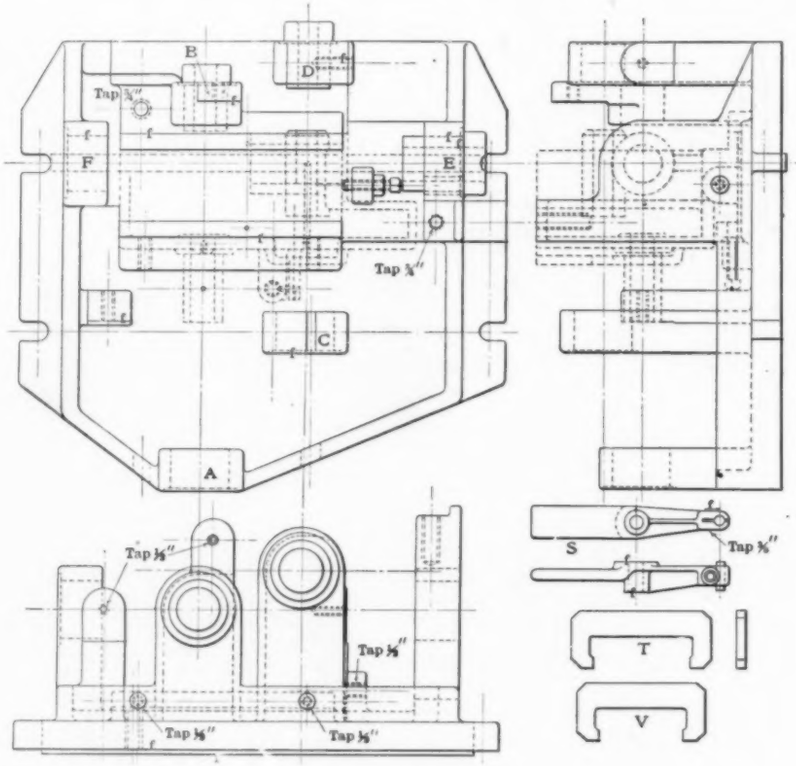


FIG. 2. THE JIG AND GAGES

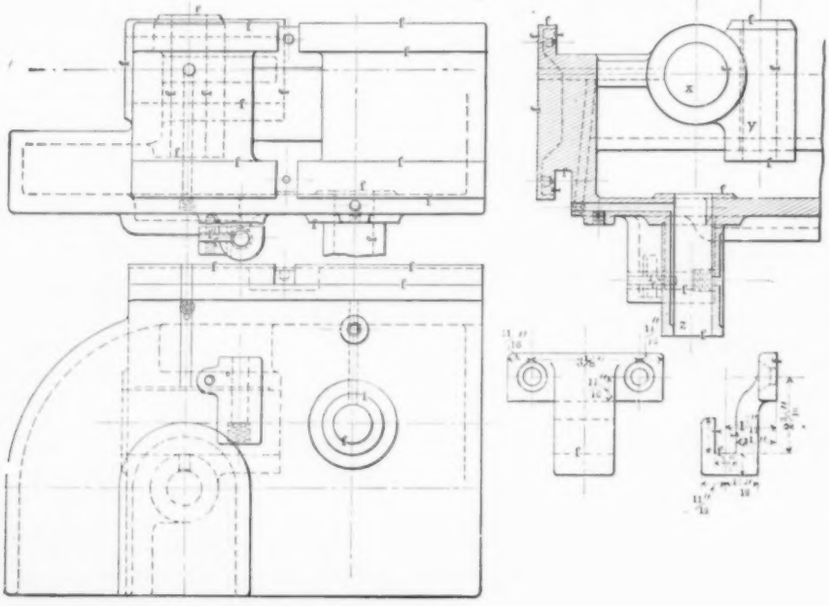


FIG. 1. THE WORK

a 1-inch finishing cutter. For finishing the faces of this hole a bar is used, with a right- and left-hand facing cutter, piloted in the finished hole, the outer face being located by a second gage *S* and the length of the bearing by a caliper gage *V*.

For the hole *z* a bushing is placed at *A* for a 1 1/16-inch roughing drill; this is followed by a cast-iron bushing for a bar the latter being fitted first with a 1.115-inch cutter, followed by a 1⅛-inch finishing cutter. The ends of this hole are then finished with right- and left-hand facing tools to gages similar to those before mentioned.

The outside diameter of the boss at this hole *z* is turned with a fixture, Fig. 3, comprising two heads, one fitted with a set of roughing cutters and one with finishing cutters, the cutters being set to a gage in each case, as shown in the illustration.

The half tones illustrate the complete jig in position with this turning fixture in place.

Some Condenser Wrinkles—How to Keep Air from Getting into the System

The following pointers may be of use to those concerned with the installation and maintenance of condenser plants—especially if for steam turbines, where good vacuum is so important:

The greatest care is necessary to keep the system free from air leakage; for the chief difficulty in maintaining a vacuum arises from such leakage. The leaks are inward, therefore invisible and hard to locate. The designer or the constructor often does not realize all that is here implied, judging from the results sometimes produced.

A source of air leakage into the condensing system is through the water supply. The stuffing boxes on the pump should always be sealed with water, and all joints on the suction line must be made up tight. The line should be carefully painted before burying it in the ground. The higher the suction lift the more care should be exercised in this work, because all air drawn in through the suction line which is subject to vacuum is discharged directly into the condenser. The fact that the pipe may be buried several feet under ground does not protect it from air leakage.

A further source of air being drawn into the condensing system is with the water through the suction line of the pump. All suction lines should be submerged not less than six feet and more if possible. The end of the suction pipe should be increased to at least twice the diameter of the pipe to reduce the velocity of the water entering the line. In a well 12 feet in diameter a 12-inch suction line was run to a centrifugal pump. The end of the pipe in the well was submerged 8 feet, but not increased in diameter. It had been observed that dry sawdust, thrown on the surface of the water, was sucked in small eddies down into the suction of the above pump. If sawdust was drawn down, it is clear that air was drawn with it. The amount of air coming down the tail pipe of the barometric condenser, discharging into the hot well, showed plainly that there was air leakage somewhere in the system, but the source of it was not located until the action of the water in the well was discovered by the engineers in charge of the plant. The remedy for this condition was to enlarge the diameter of the suction pipe in the well.

The application of two or three coats of elastic paint on clean surfaces will eliminate many of the leaks in the exhaust-pipe lines, but there still remain several places for air leaks which are not so easy to remedy. The stuffing boxes on the rods and exhaust-valve stems of the low-pressure cylinder are apt to be sources of trouble. This, however, can easily be eliminated by using double metallic packing on both rods and valve stems, and piping the steam from the receiver to the space between the two sets of packing, thereby forming a steam seal on the rod. With such a seal it is impossible for air to leak into the system through the stuffing boxes.

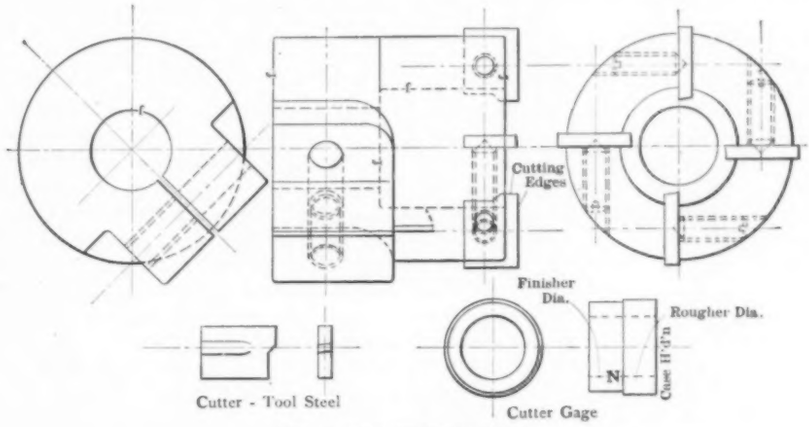


FIG. 3. THE TURNING HEAD

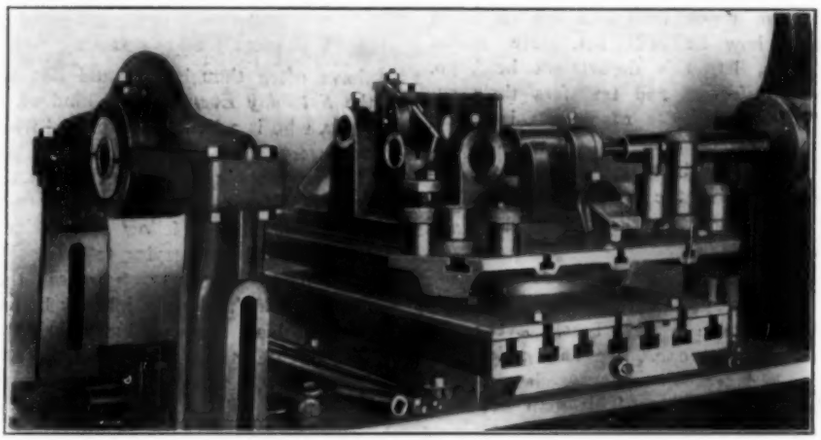


FIG. 5. FIXTURE IN USE

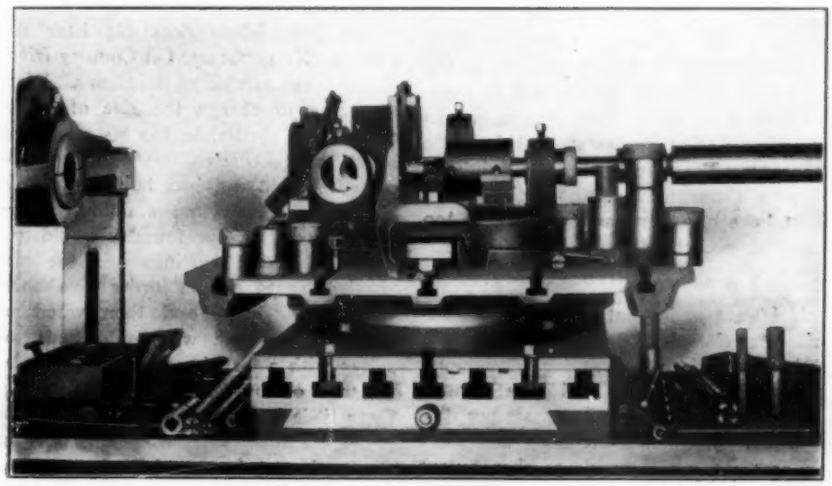


FIG. 4. FIXTURE IN USE

The new terminal building of the McAdoo tunnel system at Cortlandt and Church streets, New York, will occupy 70,000 square feet of ground and will have 22 renting floors. The building will go 75 feet below the surface and connect with the various tunnels. It is proposed to offer special inducements to capital invested in railway enterprises and in all the kindred interests such as machinery, electric and supplies, to locate in the terminal building.

The Scrap Manufacturing Company—How Great Managers Come and Go—American Manufacturing Systems

BY MICHAEL MAC MICHAEL

Did you ever compare an organization with a machine? A good machine can be set running and if you give it a drop of oil now and then it will run for a long time without attention. Not so with an organization. We can systematize and organize carefully, but let the master mind leave it, let it feel that the big boss is away and that minute you feel discipline slacken. These big corporations are like vampires: they live on the nervous energy of the men who direct them.

THE HEAD OF THE ESTABLISHMENT

We work along under one boss for awhile and his commands come down through lieutenant, sergeant and corporal to the last ten-thousandth part of this organization. He does not know us, we don't know him when he first comes in. His immediate inferiors who come in touch with him are in doubt as to how he will act. He makes changes, lets this department head go, raises inferiors and transfers their superiors. The note of reform is in the air and everyone sits up and takes notice. Then they begin to get his measure and as he thinks the machine is running smoothly he commences to congratulate himself.

THE PASSING OF THE EXECUTIVE.

Then the profits begin to fall off again and we have a new boss. Every two years we get one. We have phlegmatic men and nervous men. Dutch and Irish, they are all alike. This man has been a railroad president; this man has built up a great soap business; this man is a consulting engineer and can handle manufacturing conditions, and yet each one passes in his turn. Why is it that few big corporations have a man who can run them year after year?

CONTROLLING AN INDUSTRIAL ARMY

Sometimes I think that the man does not live who can efficiently control ten thousand men. At the works of the Scrap Manufacturing Company, if an office man and a shop man get into a dispute they cannot find a common boss lower than the manager, and he is manager of nine thousand, nine hundred and ninety-eight others. Think what it means to control an industrial establishment as large as this! Here is a man with absolute industrial power. He, and he alone, holds every man's job at his mercy, and his opinion settles a department's fate.

THE GREAT MAN'S TRIALS.

His immediate assistants play to him as a gallery and their subordinates play to them. It is all politics and log-rolling. The man does not live who can carry all the detail, and he faces combinations of his inferiors always. In a small shop the boss goes out in the factory himself and sees conditions. You might walk through our aisles for a year and be no wiser. The boss must sit in his office and get reports. The reports, some of them are true, mostly they are doctored.

A HANDY EMPLOYEE.

I pity the big boss because he is going to lose his job. Bill Smith, over across the room, was one of the original eight men who worked in the office. Bill gets $100 a month and has been getting it for 16 years. We keep him as a reference library because he remembers that Pattern No. 122 is the same as Pattern No. 96, except that we allowed finish on the under side. This pattern was made 21 years ago. Bill has seen seven managers in power since that pattern was made and has had a dozen bosses. He still holds his job and will hold it until he can no longer hobble out here. He owns his house and his family are all working. Bill can think of this when the manager goes by on the front seat of his auto.

MANAGERS WE READ ABOUT

I have often thought I would like to be the *Saturday Evening Post* kind of a manager, who is a living wonder and who knows every loose pulley in the works, but I guess that that kind must mostly be back in Pittsburg. We don't have 'em here. Our kind is a fellow who is losing his hair and sleep trying to make the business pay. I suppose, however, the manager wouldn't like my job any better than I like his. It's very lucky that the correspondence schools don't carry out their threat of carrying us all to the top for three dollars down and three a month. We all might not like it.

IDEALS OF PRODUCTION

However, every boss adds something that lasts. We are gradually realizing certain ideals. What we set out to do is to manufacture a bit cheaper than the next man an article we can sell in competition with him. Our system is so complicated that we must deal in large amounts. We must put through our shops a thousand pieces at a time. We must have our men each working at top speed at one thing.

A SCHEME OF MANUFACTURE

If I were to lay out a scheme to manufacture cheaply I would take certain articles and design them for a minimum of material and labor and then arrange to produce them at a certain rate per day. I would systematize the shop and tools so that we would work to that output every day in every department. The men would become trained to their work and our costs would continually diminish until they reached low-water mark.

THE MINIMUM COST OF PRODUCTION

This would be, if my shops were good and fixed charges low, the lowest price for making that article. Our salesmen could take our selling price based on a fair profit and be sure that no competition would last long.

This is the American ideal of production, and combined with automatic machinery and a premium or piece-work system of payment for labor, makes us competitors of the world.

THE WILY COMPETITOR

Unfortunately, however, we never can be sure our design is the cheapest and best. Ours is a brainy nation and never yet have we been able to monopolize the human brain. Some other fellow cheapens or improves the operation of our machine. He can soon put his shop conditions on a par with ours, and our market fails. We are left with expensive tools and a dead stock, and must follow closely every development in our lines to prevent this.

IMPROVED DESIGNS.

We must constantly better our designs, and this costs money; and it is this steady march of progress that makes our American ideal so hard to attain.

It is a hard thing to make our designers comprehend what these constant improvements mean. Some engineer gets a bright idea. He can change a part a little and save ten cents on machining. We are selling two thousand a month, that is two hundred dollars.

CHANGES APT TO BE EXPENSIVE

But he does not realize that we will have to throw away a thousand dollars in stock and tools and in lost business due to spoiled deliveries, to make the change. He does not think that in six months the machine will be superseded anyway. It is an absolute fact that we lose money in many cases when we change designs to cut expense.

THE HAPPY MAN WITH THE SMALL SHOP

The little fellow does not have this trouble. No doubt our Oil Country friend would laugh at this as imaginary. When he wants to change the size of a bolt on his corn sheller, he has his cored hole in the pattern changed, and his men know enough to put in ¾-in. bolts in a ⅞-in. hole. He doesn't lose a dollar. If we were to try that our foundry would turn in ten thousand castings and the purchasing agent would order five thousand ½-in. bolts, and then when we came to assemble we would find ourselves with a lot of men loafing, and one or two of us wondering who did it. Dear little man in your dear little shop, you don't know what trouble is, for just as one lump of sugar is sweet and two lumps are sweeter, so is one machinist cussed and ten thousand cusseder.

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Suggestions of Machine Operators —A Time-saving Operation in the Punch Press—How Some Pins were Cut off in the Screw Machine

I was once employed in a factory where they made a very large number of small malleable iron rollers. The only work done on these rollers was to size up the hole and chamfer or round out the edge of the hole on both sides.

OPERATIONS ON THE ROLLERS

The rollers were first dipped in hot oil and drained, after which they were chamfered in the press with tools similar to those shown at *A* and *B*, Fig. 1. This operation was performed on one roller at a time, the die chamfering one side of the hole and the punch doing the same for the other, after which a flat punch and die were put in the press and a hardened steel drift such as is shown at *C* was forced through the hole.

DOING THE WORK IN A HORIZONTAL MACHINE

These were very simple operations but I thought the work could be done more rapidly, so I began to experiment with a machine that had a horizontal ram for drifting. The drift was fixed rigidly to the ram and I arranged a chute to drop the rollers in. The drift would come up and force itself through the lower roller and as it withdew the roller would go with it allowing another roller to drop into place in the chute. As soon as the roller on the drift was clear of the chute it came against a stripper which slid it off the drift and allowed it to drop.

THE OPERATOR MAKES A SUGGESTION

The man running the machine had drifted many a barrel of these rollers in the old way; he was now having considerable trouble so he came to me with a suggestion, which was to chamfer and drift them at the same time, by the method shown in Fig. 1. The chamfering punch and die were set to allow three rollers between them instead of one, and the drift *C* was made just a little shorter than the space between the punch and die when the press was at its lowest point.

HOW THE SCHEME WORKED

The drawing shows the three rollers in position with the drift forced in them by the point or guiding tip of the punch. The top roller is shown drifted, and chamfered on both sides; it is also on the small part of the drift and is loose so as the punch ascends this roller is thrown off by the operation and another roller placed on the die. The drift and two rollers are placed on top of it, the punch descends

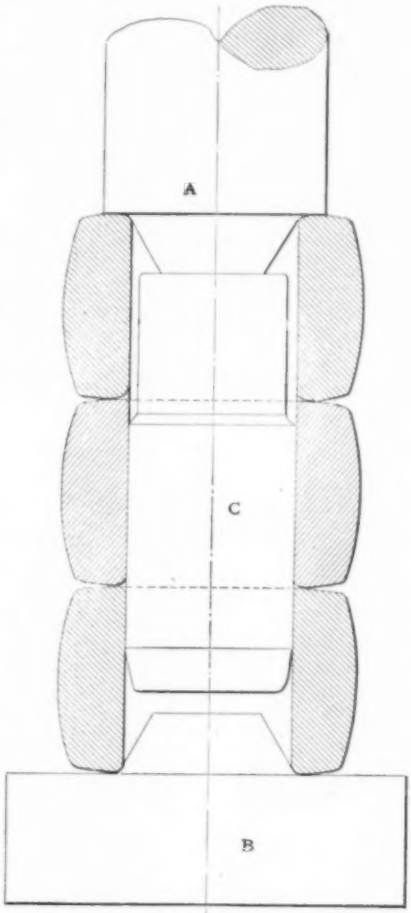


FIG. 1

A PUNCH PRESS JOB AND A CUTTING-OFF SCHEME

and another roller is finished. By this method the two operations were done in the time it formerly took to do one.

A CUTTING-OFF JOB IN THE SCREW MACHINE

In another shop they used a large number of short pins cut from ¼-inch round brass rod. These were cut off on a hand screw machine for it was necessary that the ends be square. One day the foreman gave the screw-machine operator a bundle of rods to cut up and in a remarkably short time compared with former occasions he had the job done.

A NEW WRINKLE FOR THE FOREMAN

The foreman inspected the pins and found them to be all right but the tool marks on them looked rather peculiar, so he investigated the matter and found that the operator instead of using a ¼-inch collet and cutting one pin at a time had put in a ¼-collet and cut seven at a time as indicated by Fig. 2. I do not know just how much of a saving was made here, but it is easy to see that it was considerable.

R. EARL WEINLAND.

Strength of a Cast-Iron Beam Reinforced by Steel Plate—The Repaired Punch Press

Mr. Taylor's article, "The Strength of Cast-iron Beams," which I have read with great interest, has a very stimulating question in its last paragraph, "Where is the neutral axis now?" showing a section through a reinforced cast-iron beam.

An article from me, which you published under the heading of "Repairing a Punch Press," at page 439, but which was not published in full, probably on account of the unmasterly way in which it was presented, would, if published in its entirety, have answered in part Mr. Taylor's question. I say in part, because the problem I had to solve did not admit of taking the tensile strength of the cast iron into consideration, since the beam forming the press table was broken, as shown by the drawing accompanying the article. Formula No. 8 given read

$$(8)\quad z_1 = \sqrt{\frac{2acd}{b} + \left(\frac{ac}{b}\right)^2} - \frac{ac}{b}$$

d = distance from top of beam to center of reinforcement

z_1 = distance from top of beam to neutral axis

b = breadth of beam

a = area of steel reinforcement

c = ratio of the modulus of elasticity of steel to that of cast iron, which may be taken as 2

It will be seen that the position of the

neutral axis depends only on the steel reinforcement and the moduli of elasticity of the two metals. The above formula was derived from the two following

$$(1) \qquad a s = \frac{s_2 b z_1}{2}; \text{ and}$$

$$(2) \qquad z_1 = \frac{d}{1 + \frac{s}{c s_2}}$$

which, when solved, take the form of the quadratic

$$b z_1^2 + 2 a c z_1 - 2 a c d = 0,$$

from which z_1 is found. Formulas 1 and 2 were taken from Corrugated Bars for Reinforced Concrete for 1905, but are there given in another form, which I do not find as simple as the one here given.

J. A. G. Goulet.

Some Old Applications of Mechanical Movements

In the library of the Rose Polytechnic Institute is an old book of wood cuts which possesses a considerable interest for anyone with a mechanical turn of mind.

There is no text with the cuts, which appear to form an atlas, or book of plates, to illustrate some treatise; but a manuscript note states that they are "Engravings on Wood, Illustrating the Epitome of the Art of War, by Flavius Vegetius Renati, published by Hans Knappen, at Erfurt, 1511."

The engravings, like most of the cuts of that period, are very clumsily made, and the drawing is done with a supreme disregard for the laws of perspective, yet many of them are executed with considerable spirit.

They are numbered up to CXXXXV and are intended, I imagine, to cover most of the engineering operations of warefare as it was then understood.

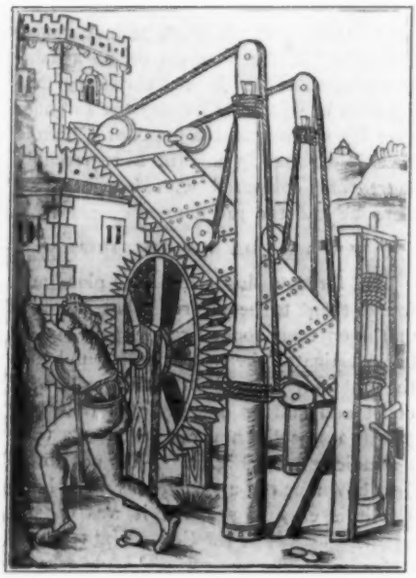


FIG. 1. RACK, GEAR, WINDLASS AND PULLEYS

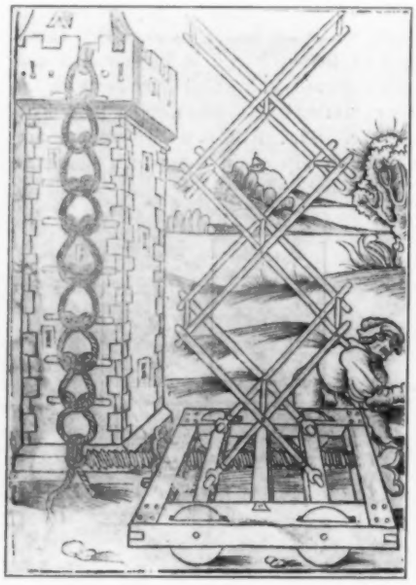


FIG. 3. SCREW-OPERATED LAZY TONGS

FIG. 5. A BALLISTA

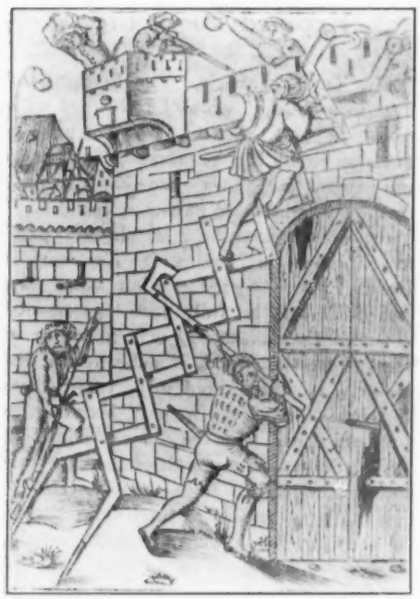


FIG. 2. LAZY TONGS SCALING LADDER

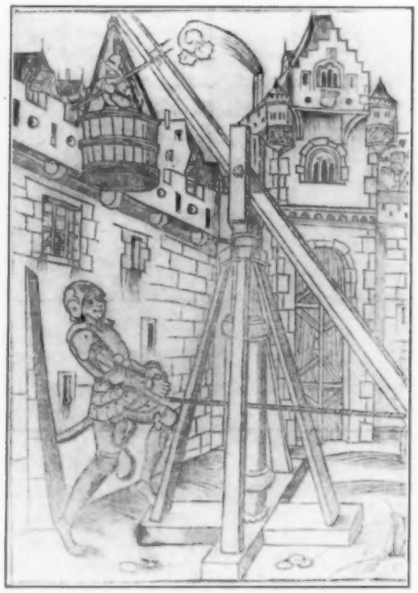


FIG. 4. AN ELEVATOR

FIG. 6. ANOTHER BALLISTA

In the absence of any text it is impossible to determine in all cases what the drawings are meant to represent, but I have spent many pleasant hours looking them over and trying to penetrate their meaning.

A fair proportion of the schemes shown have a practical look, and as they agree pretty well with the descriptions of such

apparatus which have been handed down to us in the histories of those times, they were taken, I suppose, from existing objects. Others are ludicrously inadequate to the purposes for which they were evidently intended, and are probably the imaginings of some "chamber philosopher."

They display a certain familiarity with some of the primitive mechanical elements, such as the screw, winch, pulley and lever, and occasionally make ingenious, though it may be impractical, applications of them.

I have photographed a number of typical illustrations which I thought might interest the readers of the AMERICAN MACHINIST and present them here, together with such slight comment as seems needful.

Naturally, in siege operations, scaling ladders occupy a good deal of attention, and many ingenious schemes are depicted.

Fig. 1 shows what I take to be either a device for scaling walls or, perhaps, for bridging a moat, and indicates how the platform is to be placed in position by a system of ropes and pulleys and a rack and pinion.

Fig. 2 is a sort of lazy-tongs ladder, so made, I suppose, to pack closely for ease in transportation.

Fig. 3 is another application of the lazy-tongs, and bears a close resemblance to the modern, domestic clothes horse.

Fig. 4 shows a soldier being hoisted to the top of the wall by a crane.

Fig. 5 shows a ballista. The machine is evidently just being discharged.

Fig. 6 shows another species of ballista arranged for throwing a dart by means of a sprung beam. The notches on the upright piece are probably for the purpose of getting the right elevation.

Fig. 7 shows an arrangement which seems to be going off in all directions at once, but which may be intended for a kind of rapid-fire gun, the whole affair revolving and thus bringing each piece to bear on some one object more rapidly than would be possible with a single gun.

The use of explosive shells would appear to be indicated in Fig. 8. The upper object must be some form of hand grenade, as it is hard to see how it could be fired from an ordinary gun.

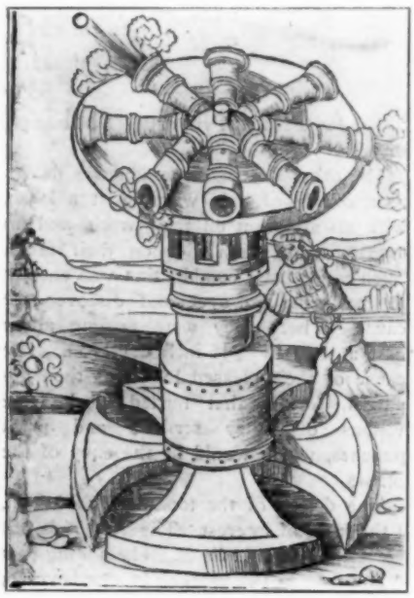


FIG. 7. A TURRET GUN

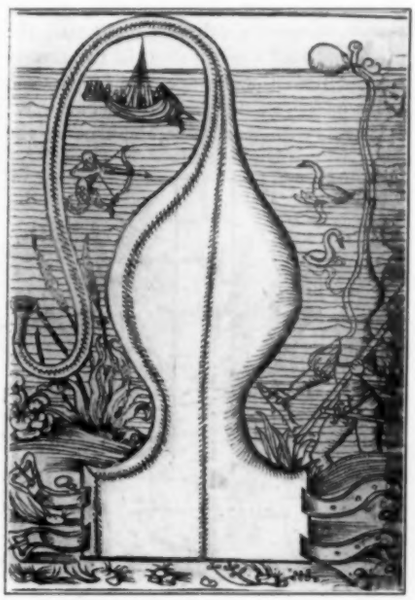


FIG. 9. DIVING HELMET AND DIVING SUIT

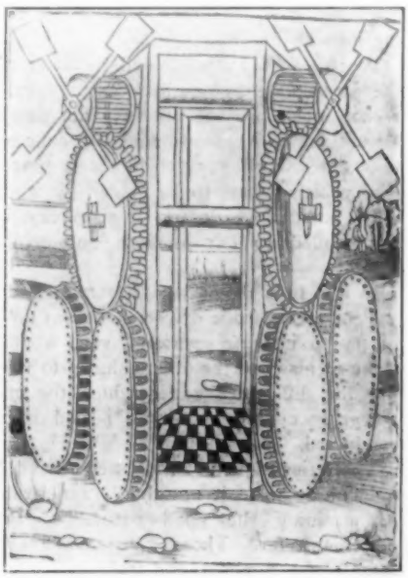


FIG. 11. AN AUTOMOBILE

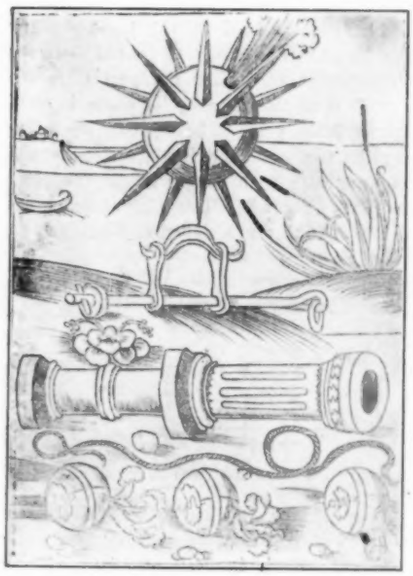


FIG. 8. EXPLOSIVE SHELLS

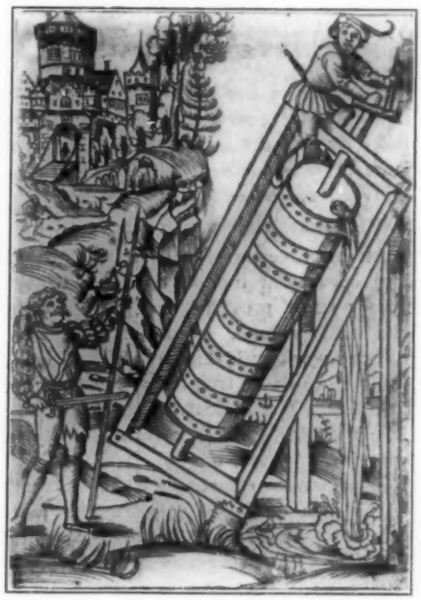


FIG. 10. RAISING WATER BY MEANS OF AN ARCHIMEDEAN SCREW

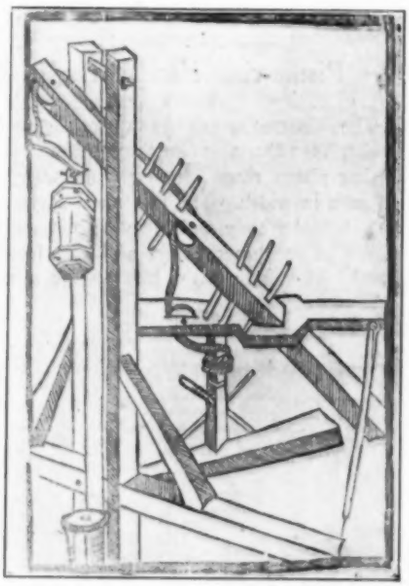


FIG. 12. A PILE DRIVER

In Fig. 9 the breathing apparatus is a tube from the top of the diving helmet to the surface of the water, the open end being supported there by a bladder.

Quite a number of water-lifting devices are shown, only one of which will be reproduced here. Fig. 10 shows what I take to be an Archimedean screw. Whether or not its purpose is to pump out the moat of the castle above is not clearly indicated. In any case the water is going to waste, and the only apparent object of the machine seems to be to furnish exercise for the man at the crank.

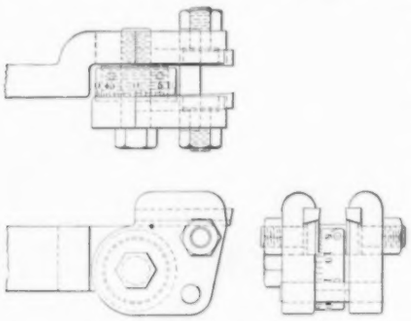
We have been accustomed to think of the automobile as another comparatively recent invention, but unless I am much mistaken Fig. 11 shows that the conception dates back several hundred years. The vehicle seems to be driven by wind mills, an idea which, for its simplicity, is commended to our modern automobile builders.

In Fig. 12 is shown what seems to be an ancient form of pile driver. One has only to try to imagine operating such a machine or many of the others shown to realize the difficulties under which the engineering operations of the period were conducted.

The series of pictures might be extended indefinitely were it not that I am afraid of straining the good nature of the editor too far. Those given are a fair sample of the whole, and I think will enable us to reconstruct with tolerable clearness a phase of the life at that time to which scant attention is paid by the ordinary historian. JOHN B. PEDDLE.

Piston-ring Facing Tool

The illustration shows a double tool, which is adjustable in thousandths, for facing piston rings ranging from 5/16 to ½ inch in width. The two main parts of the tool, the body and movable piece, are made of machinery steel and case-hardened. The body has a hub on the inner



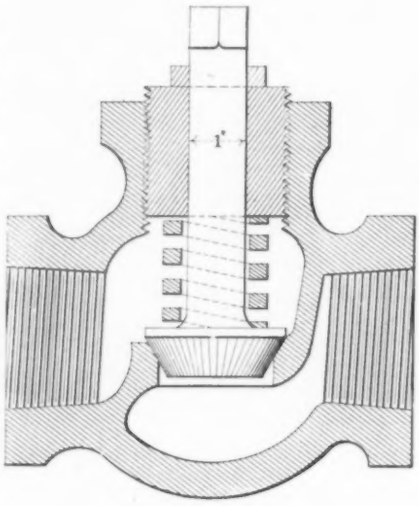
PISTON-RING FACING TOOL

side of the offset portion threaded twenty per inch, to which the graduated nut is fitted. When adjustment is required the binding screw is loosened and the graduated nut moved the required amount, with a pin wrench, then the screw is tightened again to interlock the parts. A dowel driven into the body and fitting freely in the movable piece keeps them in alinement. The inserted tools are held with bolts which have a part of their round heads cut away to form a wedge.

H. E. R. MANBRAND.

A Valve Re-seating Device made for Use in the Round House

A good many years ago I got up a little device for truing up valve seats in locomotive injector checks; a section of the valve and tool being shown in the sketch. At that time I was working in the round house and every few days we would have to take out a check valve and true up the



VALVE-RESEATING TOOL

seat and valve and then grind them to a tight fit. Of course the valve could be taken over to the shop and trued up in a lathe in short order but the seat had to be trued up in position.

WORKING WITH THE OLD TOOL

At that time the work was done with a tool beveled at the bottom and to the proper angle, provided with cutting teeth and used by hand. It took several hours of hard work with this hand tool to bring the surface down true enough to finish by grinding. The difficulty was to get sufficient pressure on the work and at the same time to hold the cutter true; and as the seats were sometimes cut a sixteenth of an inch deep you will see that there was work ahead of us, to say nothing of the fact that round-house work is generally wanted at the earliest possible moment.

THE NEW DEVICE

My device consisted of a reamer with a 1-inch shank, having a square on the top for a wrench and long enough to extend above the top of the valve body; a bushing bored to fit this shank loosely enough to turn freely and threaded on the outside to suit the thread of the standard check-valve body; and a spring of ¼-inch square steel which completed the tool.

HOW IT WAS USED

The method of using is clearly shown in the sketch. By screwing down the plug as required for feed the worst seats could be trued up in two or three minutes. All you had to do then was to take the reamer to the lathe, set the bevel to suit and true up the valve, then the job was ready to grind in. The tool was patented later by someone, but by whom I do not know. At any rate it saved me a good many hours of work and the railroad company a good many dollars.

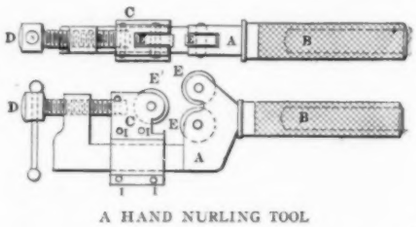
E. W. MOREY.

A Hand Nurling Tool

The other day my attention was drawn to a couple of kids working at a lathe, with all attention on their work, and an expression of high glee on their faces. Such an unusual combination was enough to make me go over and discover the cause. There they were nurling about half a yard of 3/16-inch drill rod. The cause of their pleased look was then apparent, for in that nurled stock were visions of fancy scribers and prick punches, which would be the envy of the others.

The design of the tool they used, will, I think, be of interest. The body *A* is one piece with the handle *B*. The sliding part *C* is made in two parts and riveted over *A*. This is adjusted to accommodate the stock by the screw *D*. *E E E* are the nurling rolls. *I I* are rivets. A hole is drilled in the handle to lighten it.

The tool is held in the hand, by the handle *B*. The stock is placed between the rolls at *H*. Then the part *C* is adjusted until the three rolls come in contact with the piece to be nurled. By working the tool back and forth, and by applying pressure with the screw *D* the piece is soon nurled. The advantages of a tool like this are obvious: stock can be



A HAND NURLING TOOL

nurled to the full capacity, and to less than ⅛ inch diameter; lengths can also be finished, which is not possible with the ordinary style. It is not dependent on a tool post as it is held in the hand and a speed lathe or any other will answer.

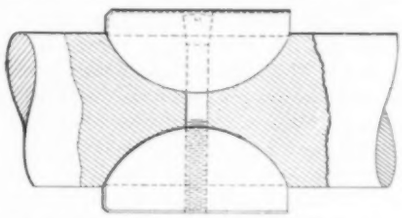
PEDRO.

Novel Boring-Bar and Cutter Scheme

The sketch shows the construction of a boring bar and cutters of original design that are in operation at the factory of the

General Vehicle Company, Long Island City. This scheme was originated by me, and has two distinct features, namely, the cutters can be expanded by papering up under them providing they wear under size, and they can be changed from one bar to another for different size holes desired by using a longer or shorter binding screw.

I use a No. 28 Woodruff cutter for making the slots in the bar and turn the cutters to suit, after which they are drilled



NOVEL BORING-BAR AND CUTTER SCHEME

by a jig, and then split, one side being tapped and the other half left the size of the screw and countersunk for the taper head. The bar is also drilled with a jig causing the hole to line up perfectly with the holes in the cutters. At the first glance one would say that under pressure in cutting with a bar of this kind, the cutters would be inclined to rock in their seats. On the contrary, the screw holds them rigidly and they work very well. I make the cutters of high-speed steel and plug the holes when hardening to prevent them from cracking.

C. W. PUTNAM.

A Sectional Die

There are a great many dies which could be made in no other way, especially large blanking and forming dies. Fig. 1 shows the blank made of tin plate.

The blank has to be very accurate. It must be parallel, square, both ends duplicate, and the holes perforated in exactly the right location, parallel with either edge. In order to do this successfully in regards to locating the holes you will notice at Fig. 2 that the die only cuts on three sides, the front and the two ends.

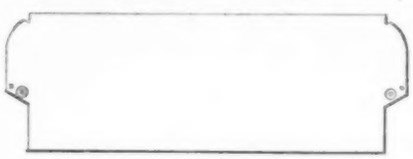


FIG. 1. THE BLANK

The sheets of tin are large enough to make four blanks. We first feed the blank in to the die far enough to trim the edge; this also perforates the holes, and countersinks two of them. The next feed completes the blank. Fig. 2 shows the blanking die. Fig. 3 is a side elevation. Fig. 4 is a top view of the punch, Fig. 5 a side elevation, Fig. 6 an end elevation. In making a die to cut tin you must use more than ordinary precaution in the workmanship as the punch and die must fit each other perfectly to cut without leaving a burred edge.

It is considered good practice to harden either the die or the punch. If it is essential to keep the blanks to a standard size harden the punch and leave the die soft. As the die wears, pene the die in and shear the punch in again, or *vice versa*, if you harden the die. This method does not apply in all cases, and it would not be successful for the job shown. In the die shown both the punch and die are hardened. The die is very hard and the punch drawn somewhat softer, but not soft enough to file.

The first essential in making a die of this kind is to make the shoe, and it must be made right, parallel and square. In this particular case, as the ends were duplicates, we doweled the two pieces together when finishing. The same also with the punch end faces. We also left enough stock for surface grinding, which would be about 0.020 in this instance, to allow for the two sides and about 0.010 for the bottom and ends.

The side cutting face, when finished, was 13½ inches long by ½ inch thick. We allowed about 3/32 inch in length and 1/32 inch in thickness for finish, and found it to be enough. Of course you would not need to allow this much for grinding only.

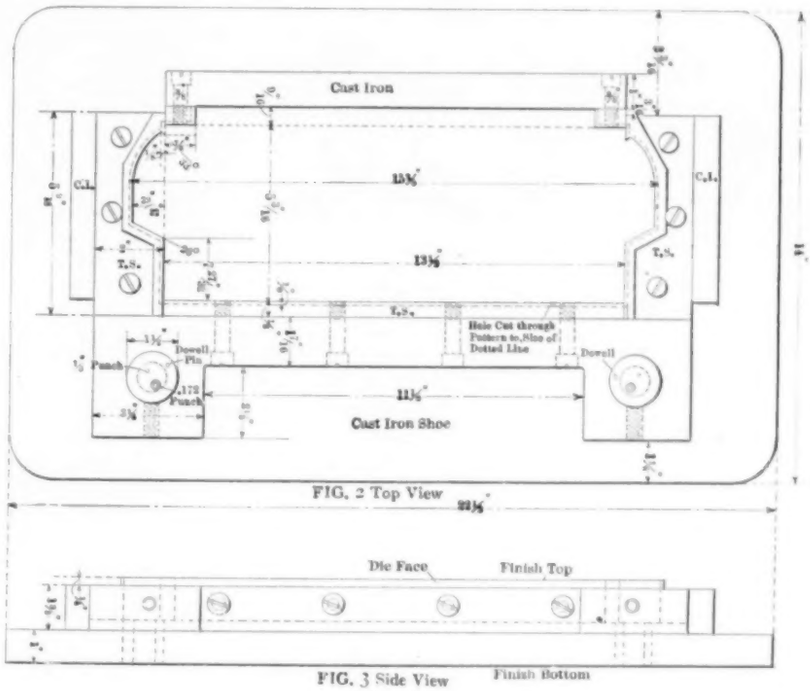


FIG. 2 Top View

FIG. 3 Side View

THE DIE

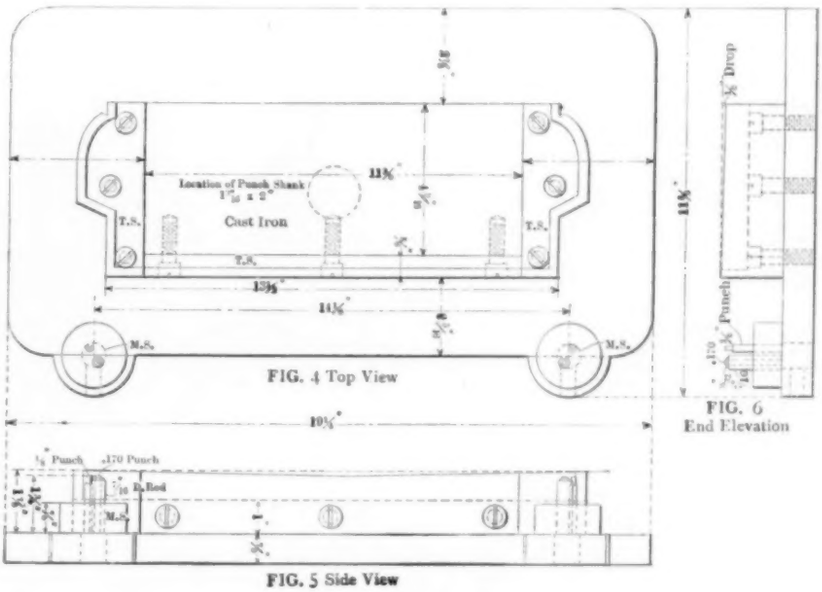


FIG. 4 Top View

FIG. 5 Side View

FIG. 6 End Elevation

THE PUNCH

but you have to allow for warping and shrinkage.

Dies made in this way are very durable and practical, for if a part gets broken you do not have to throw the whole job away.

The output of this die is 7000 per day, which I think is very good, considering the size of the blank. F. C. MASON.

Tools for Setting Shafts when Drilling Holes Crosswise

Many machinists think, when they have a hole to drill through a shaft at right angles to its axis, that there ought to be a jig, or fixture to help them get it through with some degree of truth. Some machinists have made various contrivances with this end in view.

The accompanying sketches illustrate a couple of these tools noticed in different shops.

Fig. 1 shows in section a shaft lying on the T-slot of a platen with the setting device beside it in elevation. To use this device, the scriber is set, by a scale, at a distance from the edge *a* equal to the radius of the shaft to be drilled. The scriber carrier is then secured in the top of the device, by the wing nut *b*, the nurled nut at the top is loosened, and the scriber lowered till it touches the shaft at the center dot, when the nurled nut is tightened up. The tool from which these sketches were made was designed for work up to 4 inches in diameter.

Fig. 2 shows a toolmaker's surface gage with an attachment fitted to it. In use the scriber is set approximately to the distance required, then the screw which is shown directly beneath is adjusted till it touches the shaft. The shaft is rotated till on applying the gage on either side it reads the same. CYCLO.

B—England.

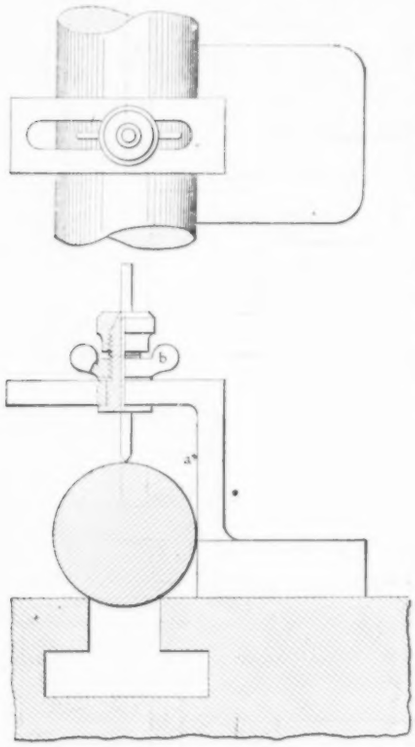


FIG. 1

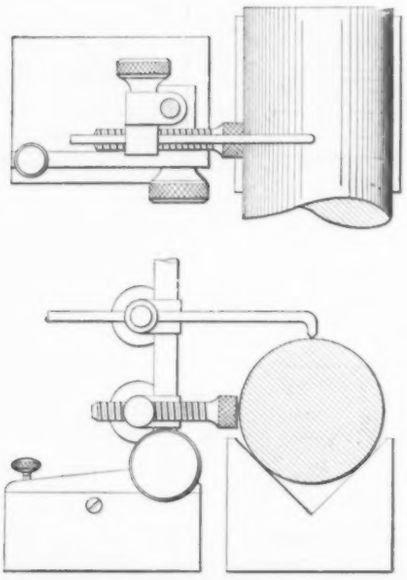
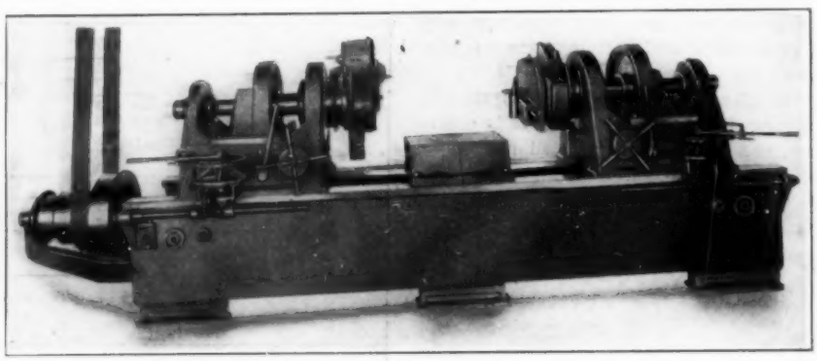


FIG. 2

TOOLS FOR SETTING SHAFTS WHEN DRILLING HOLES CROSSWISE

A Duplex Rotary Planer

The photograph shows a duplex rotary planer which I designed and constructed at the works of the National Meter Company in Brooklyn. This planer is used for machining the gray-iron bodies of large water meters, fish traps and the flanges on pipe connections. Both of the connection flanges on the fish trap and meter bodies are machined simultaneously, and the feet and upper flanges on them are machined in like manner. The flanges on the spigot and bell-pipe connections and flanges for wrought-iron pipe connections are also machined two at a time. The machine has a capacity for machining surfaces up to 36 inches in diameter on pieces up to 48 inches in length. The machine is 16 feet long over all and the length of the bed is 13 feet. The heads are moved along the bed with the horizontal levers, which engage in ratchet wheels and turn nuts on long screws with the aid of trains of miter and spur gears. The screws on which the nuts act are attached to the front of the bed with brackets. Graduated wheels above the gear casings show the movements of the heads in sixty-fourths of an inch. The quadruple levers or pilot wheels engage the mechanism for locking the heads in place. The vertical levers connect with friction clutches for starting and stopping the spindles, each of which may be stopped instantly and independently in any position for handling the tools. The spindles are made of gray iron and they run in gray-iron journals. The main journal bearings are conical, with an angle of 90 degrees, their largest diameter being 12 inches, which is behind the flanges to which the tool heads are attached. The rear bearings on the spindles are straight and are four inches in diameter. The journals for these bearings are split and tapered outside to permit adjustment with the aid of the nuts on either end of them. The main journals are solid and are driven into the heads and held in place by nuts fitted to their rear ends. The adjustment of the bearings in these journals is accomplished with the aid of nuts which are fitted to the rear ends of the spindles. Motion is transmitted to the screws in the slides on the tool heads by planetary, worm and bevel gearing, which provides a steady feed. Three change gears provide feeds of 3/64, 1/16 and ⅛ inch per revolution of the spindles. The travel of the tool slides is controlled by levers projecting from the front sides of the tool heads. The tool slides may be stopped or may be made to travel in either direction to or from the center by pushing the levers so that their drop locks spring into a corresponding notch. When the drop locks of the levers are thrown into the central notch, the power feed is thrown out and the tool slides can be brought to any position with the aid of crank handles, which are on the rear side of the tool heads. When in action the roughing cuts are taken toward the center, and when the ends of the cuts are reached, the heads are loosened and advanced a sixty-fourth or a thirty-second of an inch; then they are again locked in place and the levers



A DUPLEX ROTARY PLANER

are thrown over to feed the tools outward for the finishing cuts.

The massive construction of the spindles and all other parts of the machine prevents chattering of the tools, and there is no jerking or jumping when the tools begin and leave heavy cuts where there are gaps in the surfaces to be machined. This machine easily and constantly turns out the class of work mentioned at the rate of 3 to 1 as compared with a vertical turning mill, without more exertion on the part of the operator. The fixtures for holding the work are attached to the two platens in the center of the bed. The platens are moved apart to suit the size of the large fixtures, and one platen is used for holding the smaller ones.

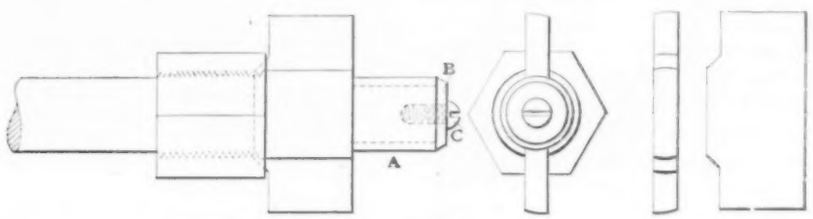
When I designed this machine I only made detail drawings and did not take time to make an assembled view or study. The photograph, which was taken after the completion of the machine, afterward did duty as a study in connection with the detail drawings, to which I made some additions for building longer machines for machining long pipes and structural columns. On these machines, in addition to the facilities for moving the heads along the bed by hand, arrangements were made to move them with power for long distances. These larger machines were built in the shops of the Fish Machine Works, in Worcester, Mass.

H. E. R. MANBRAND.

A Counterbore Using Interchangeable Cutters and Pilot Bushings

The blue-print shows a counterbore which was designed for using interchangeable cutters and bushings.

The bars are slotted as usual for the cutters, and the cutter is locked in place by the hexagon nut which has a beveled seat formed in one end as shown to fit



COUNTERBORE

over the shoulder on the cutter. The nut is made a close fit on the bar and as it is screwed down on its seat on the cutter it locates the latter centrally. Any size of bushing *A* may be placed on the tit and held in place by washer *B* and screw *C*.

To turn the shoulders on the cutter when making, the cutter is placed in the slot upside down and the nut is also turned upside down and screwed tight against the cutter. The bar is then placed on centers in the lathe and the shoulders turned. The tit end of the bar is countersunk in the screw hole for this purpose.

M. H. BALL.

Some Bending Tools

These tools were designed and made in our shop to bend the roll and wings on

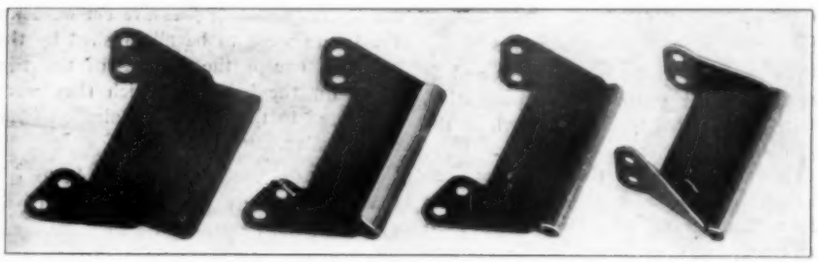


FIG. 1. THE BLANK AND THREE BENDING OPERATIONS

16-gage half-hard sheet-brass blanks to the forms in Fig. 1, where the blank and three operations are shown.

Fig. 2 shows the die in plan and elevation. The groove *A* in combination with the punch *A* (Fig. 3) produces the first bend shown at *C* (Fig. 4). For this operation the blank is put up against the stop *S*. The second bend *D* (Fig. 4) is made by the punch *B* (Fig. 3), and groove *B* (Fig. 2), a mandrel of the correct size being used to curl the brass around. The piece *S'* (Fig. 2) holds the winged end of the blank down while the second bend is being made. Fig. 5 shows the punch and die for bending the wings. There is a spring ejector in the die to throw the work out when the punch recedes.

H. E. STRUNK.

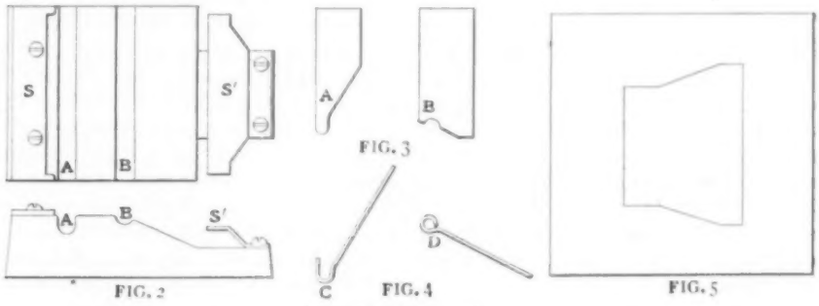


FIG. 2 FIG. 3 FIG. 4 FIG. 5

THE BENDING TOOLS

Job-shop Gages

When Tom, Dick or Harry is told to bore a hole to a certain size and no standard gages are at hand, he resorts to scale and calipers and, if he be a first-class workman, the hole will be a close approximation to the size called for. However, three holes bored by the three men would not be the same size.

Repair shops or shops doing a large variety of work cannot afford to have the large number of gages necessary to cover the wide range of sizes that occur in their work, and it is not at all agreeable to hear: "Tom, that pulley you bored two and fifteen-sixteenths the other day is back; it is a little too small"; or what is worse: "The pulley you bored is so loose that they cannot keep it tight, and are returning it to be bushed."

ACCURATE SHAFTING AND KEY STOCK

So accurate have the makers of steel shafting and steel key stock become that one may use short pieces as gages which are quite accurate enough for ordinary repair work, and in fact we have just such a lot of short pieces of shafting and key steel that we use for this very purpose.

Quite often now a machine part, say a pulley, a collar or a gear, is returned as too small, and as ordered such or such a size, and our unanswerable argument is to slip a piece of standard shafting through the "too small" hole.

A SPECIAL COUPLING

It would be amusing, if it were not so expensive, to try to make workmanlike jobs based on the meager information—and misinformation—sometimes furnished a repair shop by some backwoods mechan-

ic. We were called upon not long ago to make a special coupling; we had the old coupling—which was worn so badly that it could not well be measured—and two pieces of wire, one said to reach around the engine shaft and the other around the line shaft. We did the job and the only "kick" was at the price which our customer thought should have been the same as for a standard coupling.

PISTON RING AND OTHER FITS

We regularly make piston rings and fit them with the piston and a pine stick, which is supposed to be the length of the cylinder diameter.

The sort of work that worries one though is that which calls for a certain size a "little scant" or a "little full," as if one man's "full" or "scant" is the same as another's! We once had a good mechanic become quite indignant because we required exact figures instead of "a little full," in making a crank pin to be a shrink fit in a Corliss engine crank.

REPAIR SHOP.

The Unequal Shrinkage of Castings

The patternmaker sometimes gets a bad "set-back" for miscalculating this important detail of his work, when in reality, the mistake, if it can actually be called a mistake, was made in the foundry. Not that it is always possible to foresee the result of this process, but that the foundry could, without doubt, avoid some of these so called mistakes by a closer attention to the details of its share of the work.

Having a long acquaintance with patternmakers, I can safely say that the average patternmaker will welcome any light, or what seems to be light, on this subject. And as knowledge comes from experience, usually the experience of some other fellow, I am giving these few examples from my own experience, to encourage those of my fellow craftsmen who may be, temporarily, under the displeasure of the "old man," by reason of some alleged error of this kind.

If I can disperse the gloom, and cause the "frost" to disappear, I shall expect to receive at least a smile, in return for my efforts.

MAKING A PATTERN FOR A GRADUATED LEVER

In the early eighties I was employed by a firm engaged in the manufacture of steam, water and gas fittings. The superintendent conceived an idea for lessening the cost of safety-valve levers, which had always been made of bar iron, shaped up by the blacksmith, and graduated by first marking two or three, say for fifty and one hundred pounds, by actual trial, then dividing the space between the two marks into five equal parts, and using one of these parts as a unit to carry the graduations below fifty, and above one hundred pounds.

Having one lever graduated in this way, all others of the same size were marked from the first one. The superintendent proposed to make them of malleable iron, from a pattern which was to have the notches that had always been filed in the wrought-iron lever, located and the figures denoting pressure cut in. Thus the levers were to be all finished by the foundry, except the drilling of the two holes for the bolts by which they were connected to the yoke and spindle of the safety valve.

WHAT SHRINKAGE SHOULD WE ALLOW?

When the first pattern was ready to graduate, the question of shrinkage came up, and upon canvassing the pattern shop for information on this point, it was discovered that all patternmakers did not allow the same shrinkage, the amounts varying from one-eighth to five-sixteenths.

It was finally decided to finish up one pattern without the graduations, and send it to the foundry with instructions to make eight or ten castings, and to return the pattern for comparison with the castings. This would enable us to establish a rule of our own for the shrinkage.

SLIGHT VARIATION IN FIRST LOT

In due time the castings were received, and they varied a little in length. The pattern was a little more than three feet long, and the castings varied less than one-eighth inch in length. An average casting was selected; after drilling the two pin-holes it was tested out in the old way, and the pattern was cut and figured. It having been suggested that unless these holes were drilled from the notches, and always at the same distance apart, the valves wouldn't register correctly, it was finally decided to put the two holes in the pattern also.

Having an order waiting, and the pattern completed, it (the pattern) was sent to the foundry with instructions to hurry the work. In the meantime the other sizes of patterns were got under way, using the shrinkage as determined by the casting received from the blank lever.

CONSIDERABLE VARIATION IN SECOND LOT

When the first order of finished levers was received, the superintendent brought one of the castings into the pattern shop, and there was a short, but very warm conversation between him and the foreman patternmaker. The superintendent had a great flow of language and did himself proud upon this occasion. After he had eased his mind and gone out to have some more of the levers sent in that the foreman might see for himself how much he didn't know about shrinkage, the foreman came to my bench, for I, as you have probably already guessed, had made the pattern. Laying down the sample casting he pointed out that I had made an error of nearly half an inch in the length. I reminded him that, as he had measured the pattern himself before letting it go out of the shop, he should at least share the blame and to ease the blow I suggested that he send for the pattern and see if it was possible that he had made a mistake in measuring it.

When the pattern was received we very quickly found that it was just what we had decided to make it. The superintendent having now cooled off, he suggested that we had better make another pattern, using the latest castings to correct the length.

In order to obtain more accurate results, it was proposed by him that we should look over the entire lot and thus establish a good average. In following out his instructions in this respect, a difference in length (the pattern was between 37 and 38 inches long) of nearly three-quarters of an inch was found.

Shortly after this I had removed to B——, and was engaged in making a pattern for a large sprocket wheel. The foreman had been very explicit in his instructions as regarded shrinkage, explaining that as the circumference must be exact, in order to divide into spaces which should fit the pitch of chain to be used, and error in shrinkage would render the casting useless, and the pattern shop (a jobbing shop) would have to make the loss good.

The pattern was so made that the circumference divided into, say, twenty-nine spaces of four inches each, the four-inch space being taken from the ordinary one-eighth-inch shrink rule. As the shop had orders for more patterns using this same chain, it was proposed that the castings should be carefully tested, to prove the shrinkage. For this test a piece of stuff was made in the form of a triangle, of such proportions that if 24 inches were laid off on one side (the base), and lines were drawn across the piece at right angles with the first side, the space between these lines on the opposite side would measure 24¼ inches. This piece when cut to such a length that the hypotenuse represented the diameter of pattern, had the base of a length which we fondly hoped would be identical with diameter of casting.

WHEN THE MOLDER KNEW WE WERE MAKING A TEST

The foundry being in the same block with the pattern shop, it became known to the molders that we were to test this casting for shrinkage, and when the test was made, the casting was found to be exact when measured in line with the arms, but was slightly flattened between the arms. Was this result the effect of the molder's previous knowledge of the test to be made?

One more example and I will close. We were getting out patterns for some heavy flanged pipe. On the order was an item of four pieces about seven feet long of 14-inch pipe the walls of which were to

be 1½ inches thick and the flanges proportionately heavy. The pattern was made with an allowance of one-eighth inch per foot for shrinkage.

Of the four castings no two were of the same length, the extreme variation being nearly one-half inch, and the longest one of the lot almost exactly the same length as the pattern; when measured between the flanges over all it was actually longer than the pattern.

A cold wave swept over the pattern shop after the report of the finishing department as to the length of these castings, it being quite evident that the pattern was too long. The patternmaker admitted that this seemed to be true but pointed out that he could hardly be expected to furnish a pattern which would produce more than *one* length of casting. Then the temperature began to rise, the center of "greatest depression" moving off toward the foundry.

The specifications explicitly stated that "all dimensions of length must be exact," and that "all flanges must be spot-bored on the back side for bolts and nuts."

We obtained permission from the customer, to substitute facing for "spot-boring," then the length of pattern was altered so that face to face of the flanges was five-eighths of an inch plus the finish over the desired length of the piece while *between* flanges it was made one-eighth inch less than the finished length.

The second lot of castings varied in length not over an eighth of an inch and the shrinkage was from three-eighths to half an inch. There was a lot of stock to be turned off both sides of the flanges, but having already received the customer's permission to finish the back of the flanges in this way we were, at the cost of the extra work in finishing, able to use all of the second four. What caused the variation in length of the first four castings?

While I do not wish the reader to think that I always hold the foundry to be responsible for variations in size (shrinkage, if you prefer the term) of castings when made from one pattern, *don't you think that it is unreasonable to blame the patternmaker for such results?*

F. W. Barrows.

Tempering Steel with Cyanide—Specialist versus the All-round Man

I am much interested in the articles on the use of cyanide for hardening. The indiscriminate use of cyanide is undoubtedly a dangerous practice, but in the hands of an experienced man it will help one out of quite a number of hardening difficulties.

TROUBLE WITH SMALL TAPS

Some little time ago we had considerable trouble with some taps about 3/16 diameter. These were used in tapping thin, but tough steel which had previously been punched to tapping size as it could not be drilled. The taps when in use broke often, and the machine-shop foreman, who was rather severe on hardeners in general, made remarks that were anything but polite. We tried letting the taps down again, but they were inclined to be soft, and the metal was so tough that after tapping a half-dozen holes the top of the tap was worn away.

A HARDENING MIXTURE

We then tried a hardening solution, and were quite satisfied with the result as the taps could be hardened without any tempering whatever. We have used the bath since on quite a large number of jobs, with good results. The bath used may be of interest to your readers. It consisted of 1 pound of cyanide, 6 pounds of saltpeter, 2 pounds of common lime, ¾ ounce of permanganate of potash to 15 gallons of water.

ENGLISH MECHANICS

As regards the specialist and the all-round man, in this country the rule has been for a lathe hand or turner and a bench hand or fitter to stick to these trades, all along, but I know quite a number of expert mechanics who can make a most creditable showing on any class of work in engineering-shop practice. In a shop where I worked a position was to be filled and the foreman miller was offered the job to carry along with his own department, but his answer was: "What do I know about turners?" No doubt by this time he is regretting the money that the statement lost him. He was a crackerjack on the miller, but afraid to branch out.

TRIALS OF THE SPECIALIST

The danger of being a specialist lies in the fact that you may lose all confidence on all but one job, and on that one get a swelled head. When change of management comes around your job is not quite to the satisfaction of the new control; you cannot stand being shown anything about your specialty and throw up the job if you are given time. A foreman should have an all-around machinist's education so that he can be called upon in emergency.

EXPERIENCE GAINED IN A SMALL SHOP

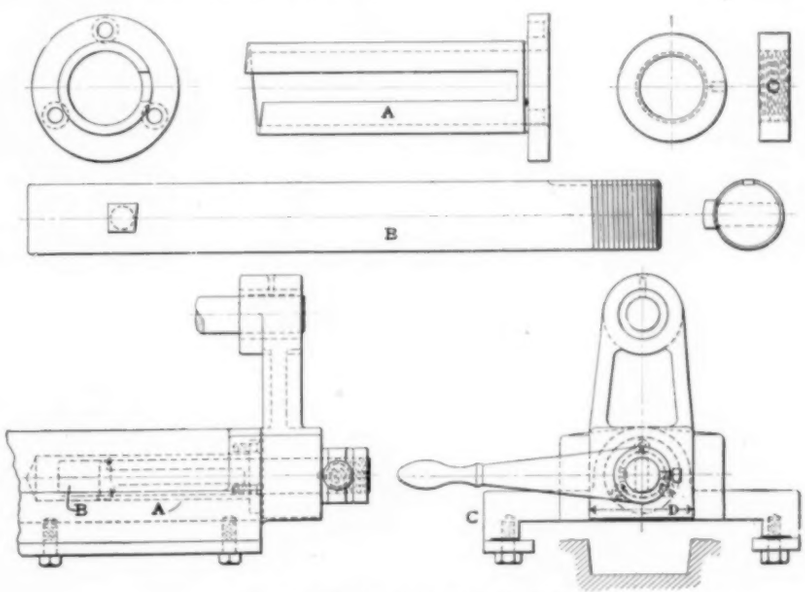
I have in mind a small shop where I served part of my apprenticeship. The crane consisted of all the shop hands around the job, and, the foreman shouting "Heave Ho!" away we carried the load to where it was wanted. We never knew what the next job would be nor where it was going to come from, and the work was anything from machine tools to well boring, but on looking over the men who received their training in that shop I find that without exception they are all doing well and are in positions of trust as foremen or shop superintendents.

B——, England. Hardener.

Locking Device for Boring-bar Support

A rapid device for locking a support for a boring bar is shown in the accompanying drawing.

A is a steel sleeve with a spiral cut on the end and slotted to the length shown,



LOCKING DEVICE FOR BORING-BAR SUPPORT

through which passes the bar *B* containing a pin beveled to conform to the spiral on the sleeve. The whole is contained in the saddle *C* into which is fitted the support at *D*.

The arrangement is shown in locked position. To release, the bar *B* with the lever is turned so that the pin will travel along the slot in the sleeve, permitting the support to be withdrawn and dropped down out of the way when work is taken from or put on the machine. G. L.

CONDITION OF INDUSTRIES IN NEW JERSEY

Wages—Hours of Labor—Cost of Living

New Jersey, being one of the oldest and most important States in manufacturing, having a very large proportion of her citizens engaged in industrial establishments of almost every conceivable kind, is of especial interest so far as wages, cost of living, etc., are concerned. Therefore, the following figures from the report of Winton C. Garrison, chief of the State bureau of statistics, are worth noting.

Chief Garrison's report shows that there are 2018 manufacturing establishments in New Jersey. Of these, 1197, or 59.3 per cent., are under corporate management, and 821, or 40.7 per cent., are controlled by private firms or individual owners. The report says that the corporate form of management of industry is steadily growing in favor, the rate of increase averaging about 1.6 per cent. for each year since 1902. The capital invested is $521,090,460.

The report shows the average number of persons employed during the year in the 2018 establishments to have been 239,113, of whom 173,859, or 72. 7 per cent. are males, 58,897, or 24.6 per cent., are females, and 6357, or 2.7 per cent., are children of both sexes under 16 years of age.

The total paid in wages by all industries was $116,805,243, which does not include salaries of officers, superintendents, managers, etc. The average yearly earnings for all industries is $488.49; in 1904 the average yearly earnings per employee was $470.47; the increase of yearly earnings is therefore $18.02, or 3.8 per cent. The industries showing the highest average yearly earnings of wage-workers are: "Brewery products," $849.37 and the manufacture of "varnishes," $736.59. Of the eighty-nine industries presented, eighty show increases in the earnings of labor, and only nine show decreases.

Taking males, females and young persons together, for all industries, the table shows that 36,714, or 13.9 per cent. of the total number are paid less than $5 per week; 57,843, or 21.9 per cent., are paid wages ranging from $5 to $8 per week; 86,801, or 32.8 per cent. are paid wages ranging between $8 and $12 per week; 76,608, or 29 per cent., are receiving wages ranging between $12 and $20 per week, and 6361, or 2.4 per cent. of the total number, are in the classes receiving over $20 per week.

The table of working hours shows that 1065 men employed in the production of "pig iron" work 12 hours per day, 2287 others employed in several different industries work an average of 10.50 hours per day, and 45,456 wage earners of both sexes report working 10 hours per day. Twenty-two establishments engaged in the production of "metal cornices and skylights" show average working hours of 8.40 per day; in the manufacture of women's and children's underwear, twenty establishments report an average workday of 8.20 hours. All other establishments report working time ranging from a fraction more than 9 to a fraction less than 10 hours per day.

Three hundred and sixty-seven establishments are reported as having run "overtime" during the year, in order to keep up with the demand for their products, the busiest in this respect being the manufacture of various types of "machinery."

The total number of miles of railroad within New Jersey was 1,632.24 in 1906; in 1905, there were 1628 miles, an increase of only 4.24 miles during the year. The number of workmen employed in all capacities was 42,702, in 1906; in 1905 the number was 38,000, an increase of 12.4 per cent.

The average wages per day is $1.98 in 1906; in 1905 the average was $2.06, an apparent falling off of 8 cents per day. The average yearly earnings per employee is shown by the report to be $563.40, as against $610.46 in 1905, a decrease of $47.06. This falling off in average daily and yearly earnings is, to a large extent, accounted for by the fact that the average number of days on duty during the year 1906 was 285, against 296 in 1905.

The report presents, in a series of tables, the retail prices for a selected bill of goods that includes the ordinary standard table supplies for families of average means. These prices were obtained from old-established dealers in all parts of the State, and apply in all cases to the month of June.

This inquiry has been made annually from 1898, the purpose having been to show the varying efficiency of the wages in procuring the ordinary fundamental necessaries of life, it being a self-evident fact that the value of wages depends not on the sum of money earned, but on its purchasing power.

The report says that the figures show that the cost of living, so far as the plain, ordinary table supplies is concerned, has advanced an average of 4.6 per cent. for each year since 1899. The largest increase —12.9 per cent.—occurs in 1904, when there was a considerable expansion in the prices of flour and meats, which fell off again to nearly normal figures during the two subsequent years.

Averaging annual earnings show an advance of 6 per cent. to have taken place, as against 4.6 per cent. increase during the same period in the cost of these supplies. The difference, however, between the increase of income and outlay is 1.4 per cent. in favor of the former.

The report says that this comparison by no means proves the advance in wages to have exceeded necessary expenditures for the general requirements of life; the small preponderance of earnings referred to above will probably disappear in the increase of house rents, cost of fuel, and many other requirements of personal and family use.

Japanese Government Buys Steel Works Equipment Here

Contracts are being placed here for the equipment of huge steel works which the Japanese Government is to operate under the name of the Imperial Steel Works on the island of Moji. The contracts are being handled through the New York offices of the three Japanese contracting firms of Mitsui & Co., Takata & Co., and Okura & Co., who are acting for American manufacturers.

The Japanese plant will entail a cost of about $10,000,000. The orders for equipment so far call for two bar mills, tube mill, blooming mill, rolling tables, furnaces, cranes, and a general line of steelmaking equipment.

In addition to furnishing the equipment for the Imperial Steel Works, Americans will also ship a general line of machinery for a big lead mill and a complete outfit for a tin-plate mill, which private Japanese interests are to construct in the vicinity of Kobe.

Plain and Universal Grinders

The accompanying half-tones illustrate two machines forming part of a line of plain and universal grinders of recent design.

In designing these machines, a rigid bed has been provided, cross-webs being placed to tie the sides firmly together; and the construction of the table mechanism is such as not to require a removable front plate. When it is desired to take out any of the internal parts it may be done by running the table over to one end of the bed. The ways provide ample bearing surfaces and are provided with automatic oiling pockets.

THE TABLE

The table is driven by worm gearing and the adjustable dogs which regulate the travel are so arranged that the table may be run past the reversing lever without the adjustment of the dogs being changed. The swivel table turns on a central pivot and is clamped at both ends firmly. The reversing mechanism is mounted in a bracket bolted to the outside of the machine, where it may be easily oiled; the bracket may also be taken off at any time if it is desired to clean the mechanism or inspect it for any purpose.

HEAD AND FOOT STOCKS

The head stock on the universal machine swivels on a graduated base and, like the foot stock, is gibbed to the side of the swiveling table, this arrangement permitting large wearing surfaces and providing a positive edge, so called, of sufficient area to retain for a long time the alinement of head and foot stocks, both of which are secured to the table by clamp gibs.

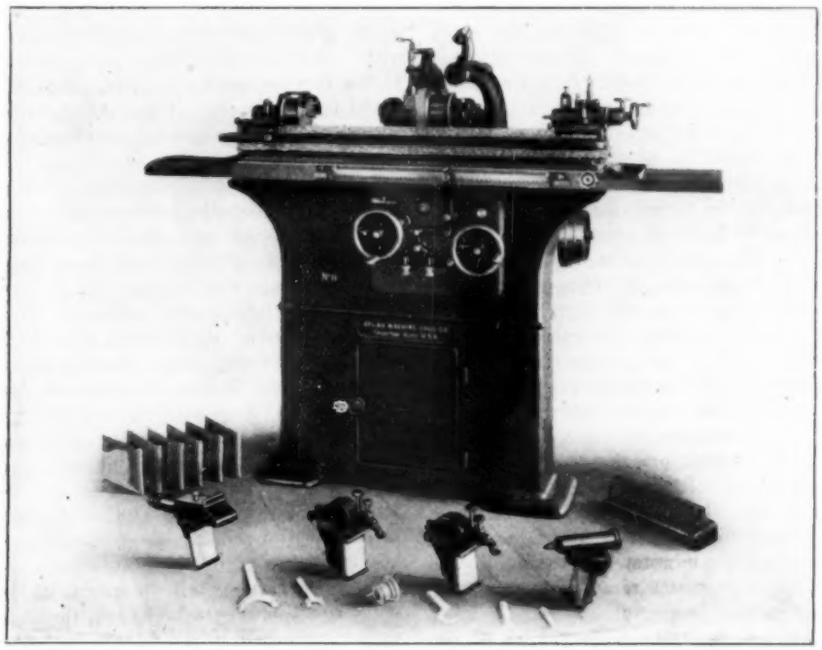


FIG. 1. PLAIN GRINDING MACHINE

SPINDLE AND WHEEL

The wheel spindle is of tool steel, hardened, ground and lapped, and runs in phosphor-bronze bearings of ample dimensions and provided with means for taking up wear. The wheel is mounted midway between the bearings and, when changing wheels, the spindle may be removed from the stand by simply loosening two clamp nuts.

Automatic cross feed is fitted to both plain and universal machines. By means of this the wheel may be moved up to the work from ⅛ of a thousandth to two thousandths of an inch at each reversal of the table and automatic attachments are included for stopping the feed of the wheel when the work is to size. Also a simple hand attachment is fitted for fine hand speed.

OTHER FEATURES

Universal back rests are included in the equipment accompanying these grinders and each machine is provided with a diamond tool holder located at the end of the foot stock so that the wheel may at any time be easily trued up in place. A pump and tank are attached to the side of the machine bed for supplying an abundance of water to the work.

SIZES AND CAPACITIES

Two sizes of each type of grinder are manufactured. The universal machines take respectively 26 and 52 inches between centers, swing work up to 9 and 15 inches in diameter, and will grind tapers up to 1½ and 2 inches per foot. The smaller of the two plain grinders receives work up to 5 inches in diameter and 31 inches in length, while the other is suited for work up to 8 inches in diameter and 44 inches in length. The former is suited for grinding tapers up to 1¾ inches per foot and the larger machine for tapers up to 2 inches per foot.

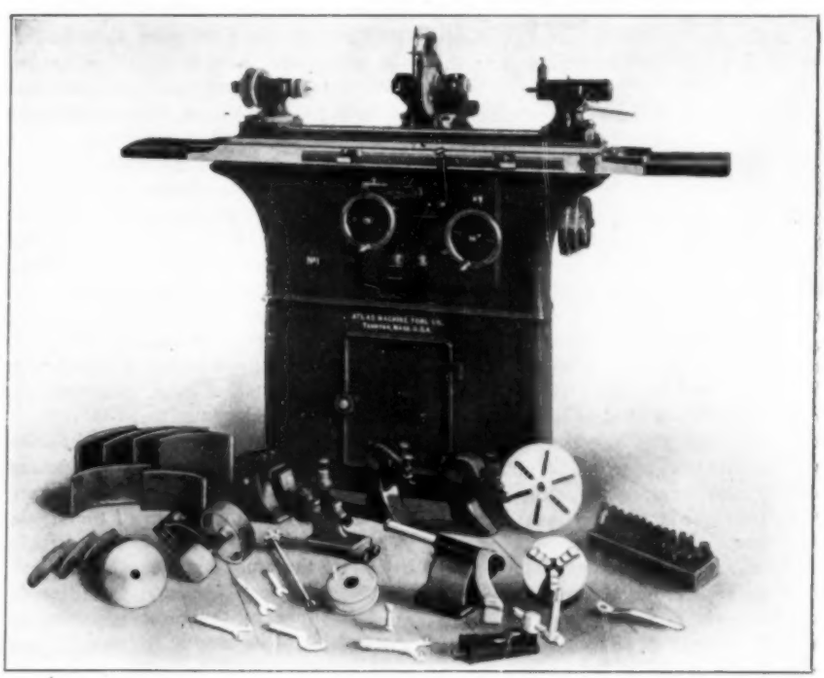


FIG. 2. UNIVERSAL GRINDING MACHINE

These grinding machines are built by the Atlas Machine Tool Company, Taunton, Mass.

The Sandy Hook Coast Defenses

Our account of the visit of the A. S. M. E. to Sandy Hook, and what took place there, formed a part of the general report of the fall meeting of the society, and was necessarily much condensed. It will interest many of our readers to read a carefully prepared description of what was seen there, which description we find in the columns of the *Scientific American*. It is as follows:

The invitation by the United States Government to the members of the American Society of Mechanical Engineers to pay a visit to that most sacred of all Government reservations, Sandy Hook, was a greatly appreciated courtesy to one of the most distinguished and influential technical bodies in this country. The invitation was extended in connection with the recent convention of the society, and, as usual, the Government treated its guests exceptionally well, $8000 being appropriated for the practical exhibition of the working of the many elements of defense in the way of guns, mines, mortars, etc., which render Sandy Hook one of the most formidable of our seacoast defenses. The seven hundred guests of the Government were taken down to Sandy Hook in a special train of ten cars, and the first stop was made at the southerly end of the proving grounds for the purpose of visiting the great 16-inch army gun, the largest and most powerful rifle in existence. This piece is still mounted on the temporary trial carriage on which it was proved some two or three years ago.

The gun weighs 130 tons and fires a shell weighing 2450 pounds with a velocity of slightly over 2300 feet per second, and an energy of about 80,000 foot-tons, over 600 pounds of smokeless powder being necessary to secure these results. Although it is not likely that the gun will be duplicated, the piece will be permanently mounted at Sandy Hook, and will form a very valuable element in its defenses. It may be remarked in this connection, that the recent determination of the ordnance board to abandon the manufacture of guns of high velocity in favor of larger guns of low velocity, lends a new significance to the 16-inch gun, and if it should be decided to adopt for this piece the 2000-foot-seconds velocity, which is to be the service velocity of the future, the 16-inch gun will become in a sense rejuvenated, and may be considered to have before it a long period of future usefulness. Two or three hundred yards to the east of the big gun, the visitors were shown two targets representing the side armor, backing, and framing of our latest armored cruisers and battleships, which have lately been erected for the purpose of testing their resisting power to the attack of modern shells. It was noticed that the targets, instead of facing the guns, have been built with their face at a sharp angle to the line of fire; and it was explained that this was done in order to test the resisting power of the armor when struck by shells delivered at an angle twenty degrees from the normal. As a matter of fact the majority of the projectiles which reach a ship strike her obliquely; comparatively few of them are delivered normal to the plate.

The visitors were next taken down to the massive concrete emplacements upon which the various guns which are submitted for proof are tried out. Here, two rounds were fired at a velocity of 3000 feet per second from one of the largest type of 6-inch rapid-fire guns mounted on a barbette carriage. The small interval of time before the shell struck the water, over a mile away, afforded a dramatic illustration of what is meant by a muzzle velocity of 3000 feet per second. Then followed five rounds from a 15-pounder, semi-automatic, rapid-fire gun, and three rounds of shrapnel from a 3-inch field gun which were timed to explode above the water at about 1000 yards range. As the shots were fired to leeward before a 35-mile gale, the sound of the exploding shells could not be heard, and the only evidence that the heavy rain of fragments was being duly scattered was the appearance above the water of a little white ball of smoke, looking for all the world like a puff ball hanging in mid-air. Other tests at this battery consisted of the firing of a 4.7-inch siege gun, mounted on a long recoil carriage; and a 2.38-inch field gun; and ten rounds from one of the famous 1-pounder pompom automatic guns. From the spectacular point of view, the most interesting exhibition was the firing, with full charge, of a 10-inch rifle mounted on one of the Buffington-Crozier disappearing carriages. This mount, whose design is chiefly due to General Crozier, of the board of ordnance, who was present to receive the guests, is now the standard type of mounting for all the heavy guns of the United States coast defenses. The shell struck the water at a range of about 2½ miles, throwing high into the air a huge geyser of water. Richocheting, it took another great leap of fully a mile and a half, when it struck again, throwing up another large column of spray, before it finally passed out of sight.

The party then passed on down the beach to the formidable fort known as Battery Richardson, where a large number of 12- and 10-inch guns are mounted on the Buffington-Crozier disappearing carriage. After a 12-inch gun had been raised into battery, traversed, and returned to the loading position, General Murray, mounting the parapet of the emplacement, delivered an address in which he contrasted the best firing results obtained in target practice a few years ago with those of the present year. Five years ago the best results that could be obtained with the 12-inch gun were one shot in three minutes, and the percentage of hits was 50 at a range of from 4000 to 4500 yards. During the intervening years, thanks to the admirable system of fire control (that is, the method of locating the target, and ranging the guns), the work of our gunners has improved so greatly that last year more than half of the guns fired made a record of 100 per cent. in hits, the range has been increased to 4000 yards, and the average time between shots reduced to one minute.

The visitors then passed on down through the fort to another emplacement, where they were treated to an exhibition of sub-caliber target practice, in which a rifled tube, representing a 1-pounder gun, is placed centrally within the bore of a 10-inch rifle, and all the motions of unlocking a breech, loading, closing the breech, sighting, etc., are gone through exactly as though a full-weight shell and powder were being used*.

Considerations of expediency prevent any detailed description of Fort Richardson, and it must suffice to say that the provisions for the safe storage of the powder and shells, the arrangement of the lifts for bringing the ammunition up to the guns, etc., are thoroughly up-to-date and render this fort one of the most complete and formidable of its kind in the world.

All systems of defense of the entrance to the harbors include, in addition to the heavy guns for the attack for armored vessels, provisions for sowing the channels with the deadly submarine mine. The submarine defenses of the Sandy Hook channels are particularly complete. They are arranged on the electrically controlled system, and have been carried out on the lines which have been illustrated from time to time in the various issues of the *Scientific American*. By this system it is possible to discriminate in the treatment of friend and foe. When a ship strikes a floating mine, an electrical contact is made which gives notification to the operator within an armored casement on the shore. If the ship be a friendly vessel, it is allowed to pass on; but if not, the operator immediately throws a switch and explodes the mine.

From the mining casemate the visitors were next taken to the hidden mortar batteries, from the crest of which they looked down 60 or 70 feet into a series of huge rectangular pits, at the bottom of each of which were four short, massive, rifled mortars, capable of throwing a 12-inch shell to the extreme range of seven miles. For the benefit of the visitors, a salvo of four guns was fired with reduced charges, the guns having an elevation of about fifty degrees. At the word of command there was a reverberating crash, and instantly the eye was able to follow the skyward sweep of the four projectiles which, keeping the same relative four-square position in which they left the muzzle of the guns, could be seen soaring into the blue, drawing together under the effect of perspective, and diminishing until they were lost to sight. A few seconds later, after they had described a vast curve, whose highest point was a mile and a half above the earth, a cloud of spray thrown up from the ocean some three miles distant from the shore marked the point at which they fell. The exhibition closed with the firing of shells loaded with high explosive or with black powder, and the explosion of a powerful land mine. The latter lifted what appeared to be a veritable mountain of sand, earth and broken timbers high into the air, and afforded a most impressive demonstration of the destructive power of this, the most formidable of all methods of attack.

*In such practice the size of the target and its distance from the gun are reduced in proportion, so that the sighting is virtually the same as in full-caliber practice, and the marksmanship of the men is much improved. —Ed. A. M.

Remington Typewriter Christmas Bonus

The eighth half-yearly distribution of a bonus to the most efficient employees of over ten years' standing took place on Saturday, December 22, in the Factory Hall of the Remington Typewriter Works of Wyckoff, Seamans & Benedict at Ilion, New York. The number participating—269—was the largest since the scheme was instituted and $13,450 in gold was divided, giving $50 for the half year to each person. A similar distribution takes place each June. The following periods of continuous employment were represented out of a total of 1700 employees: three men over 33 years, six men over 25 years,

thirty-nine men over 20 years, ninety men over 15 years, and one hundred and thirty-one men over 10 years. The prizes and certificates for good suggestions adopted during the half year were presented at the same time.

American Trade with the Levant and Its Possibilities

We have received from Aris. Tsakonas, of 5212 Jefferson street, Philadelphia, Penn., a pamphlet on this subject, which he has prepared after years of technical and commercial experience in Athens.

At the outset the author speaks of the influence exercised by the Greek element over the Balkan States, Turkey and Egypt, and shows by statistics for 1905 the importance of Greek shipping interests. He then tells how American goods are at present made known and disposed of in the Levant, the methods including direct correspondence with American firms, and the employment of American traveling representatives, or of agents in Europe.

In describing the shortcomings of these systems he says that the first method seldom results in actual business; one reason being that American firms in replying to inquiries, generally write in English, though occasionally in French or Spanish, and also send matter printed in these languages none of which is understood by the people addressed, who, consequently, throw the catalogs into the waste basket and leave the letters unanswered. Also, the criticism is made that American letters are too brief and inexplicit to enable agents to give desired information to prospective customers.

In regard to American traveling representatives the author states that they seldom speak any language but their own, and the same criticism is applied to European agents or sub-agents doing business in the Levant. He cites various instances coming under his own observation of business lost through inefficiency of representatives and states that agents without technical knowledge of the material they handle are a hindrance to American export business.

In conclusion two ways are suggested for developing trade in the Levant. One is the organization in the Commercial Museum of Philadelphia of a Levant Department having for its object correspondence with that part of the world in Greek, the furnishing of drawings where necessary with offers of goods, the translation of catalogs, price lists, etc., into Greek, and the sending of an expert to the Levant every year or two to study the commercial situation there and report in detail upon its market conditions and requirements. The other proposition is a permanent exposition of manufactures and articles of commerce in Athens, this also to be a distributing center for catalogs and other printed matter in the Greek language.

Strong Competition in England between the Suction Gas Producers and City Gas Plants —An Invention for Using Bituminous Coal in the Suction Producer

According to a report from Consul Albert Halstead, of Birmingham, the English borough of Walsall has decided to reduce the price of gas to manufacturers from 54 to 48 cents per 1000 cubic feet. The consul writes:

A short time ago the Birmingham city authorities reduced the price of gas to manufacturers who use small engines to 38 cents. The tendency throughout this section of England is for the price of gas, made either by local authorities or private companies, to be reduced to manufacturers. This shows not only the trend toward an increasing use of gas for power purposes, but also a determination to meet the new and vigorous competition of the handy suction producer-gas engine plant and other modern methods of gas production in individual plants for gas-engine use, which has steadily grown in recent years. Already suction gas engines above 15 horse-power have practically captured the field, and the effort now is to save to the local gas authorities and gas companies the field for gas engines of from 10 to 15 horse-power. The manufacturers of suction gas engines are in turn already preparing to meet the competition of the gas authorities. One difficulty that the manufacturers of suction producer-gas engines have had to meet is the fact that the successful suction producer-gas engine power plants, as now made, require pea anthracite or coke.

A patent has recently been applied for, however, which the inventors, who are successful suction producer-gas engine plant manufacturers, believe will make it possible to use bituminous coal for suction producer-gas work. If this patent proves successful, there will be an immediate increase in the use of suction plants, because of the greater cheapness of bituminous coal in England. The success of this invention would be very important to many sections of the United States where anthracite gas producers are not practicable because of the cost of the fuel. The benefit to communities in the United States whose atmosphere is now blackened by coal soot that would result from the general use of gas engines need not be emphasized.

Safety of Concrete Structures

There have been of late so many failures of concrete structures that the questions of what is the cause of these failures, and whether or not they can be avoided, are becoming important. Our contemporary, the *Engineering News*, has paid considerable attention to this matter, which comes especially within its field, and its conclusions are stated as follows:

The observed facts impel the lay reader to one definite conclusion: That reinforced concrete is a dangerous building material, dangerous for unknown reasons, among which may be these: either (1) because safe methods of design have not yet been developed, or (2) because the commercially obtainable materials of construction are subject to unknown variations which may produce fatal weakness, or (3) because the quality of labor employed is not high enough to insure the safe construction of the design, even though design and materials be satisfactory. To this conclusion we are regretfully forced to subscribe. We make but one reservation—namely, that if an independent engineer be employed to either work out the design, or to prescribe specifications and verify the design by them; and if further an independent engineer be placed in charge of the construction work to see that it is properly done, then reinforced concrete construction is as safe as other types of construction. Under all other circumstances we believe it involves so much risk that it must be characterized as dangerous.

Meeting of the Technical Publicity Association

The Technical Publicity Association devoted its meeting of December 20, at the Aldine Association rooms, 111 Fifth avenue, New York, to the subject of "The Value of Circulars and Printed Matter." Frank Vreeland, art editor of the *American* Printer, spoke of the commercial value of beauty in typography, and Walter Gilliss, president of the Gilliss Press, New York, made some remarks about limited editions. The companies represented at the dinner by members of the association, which is confined to those connected with the advertising departments of machinery-manufacturing industries, were as follows: Ingersoll-Rand Company, T. R. Almond Manufacturing Company, Pope Manufacturing Company, H. W. Johns-Manville Company, Yale & Towne Manufacturing Company, John A. Roebling's Sons Company, American Locomotive Company, General Electric Company, Patterson, Gottfried & Hunter, New York Edison Company, M. H. Treadwell Company, Crocker-Wheeler Company, and A. S. Cameron Steam Pump Works, and Lidgerwood Manufacturing Company. The meeting developed into an "experience meeting" and many of the members told of their methods and results with printed matter and circular letters. As usual at the monthly meetings, several new members were elected.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E.C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1906 the AMERICAN MACHINIST printed and circulated 1,083,250 copies, an average of 20,832 per issue. Of this issue 32,500 copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.

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A Movement for the Reconcentration of the Machinery Trades in New York

The demolition of several buildings in the machinery section of lower New York has resulted in the scattering of machinery-building establishments that were formerly located in a reasonably concentrated manner, the present locations extending all the way from the Battery up to nearly Twenty-third street.

The great Fulton building which is now in progress of erection on the block bounded by Fulton, Dey and Church streets, and over the terminal station of the Hudson Company's Hudson River tunnel, presents an opportunity for bringing these various interests together again, and a movement in that direction has been started by Francis H. Stillman, president of the Watson-Stillman Company. A meeting has already been held, and a committee appointed to canvass the machinery interests of the city. This committee consists of representatives of the American Locomotive Company, the Ingersoll-Rand Company, the Morris Machine Works, the Frevert Machinery Company, the Prentiss Tool and Supply Company, the Watson-Stillman Company, the Railway Steel Spring Company, the Hooven-Owens-Rentschler Company, and the Franklin Boiler Works Company. The committee has prepared a circular letter in order to gather the sentiments of the trade, and while it would be premature to say that the success of the plan is assured, we understand that there is reasonable prospect of its going through.

The connection of this building with the tunnels under the Hudson river makes it feasible to erect a warehouse for the display of machinery in Jersey City, which would be distant not more than ten minutes time from the office building.

The building is to be of immense proportions, with capacity for taking care of an office population of 10,000 people. It will contain thirty-nine elevators and five restaurants, and have immediate connection with the subway and elevated railroads. The plan is of such obvious importance and merit that it certainly deserves success.

Delayed Freight Shipments

At a recent meeting of the Leather Belting Manufacturers' Association, C. O. Alexander, of Philadelphia, presented an address on "Delayed Freights," a subject which is just now very much agitating the minds of manufacturers and business men generally. The fact seems to be that our boasted system of railway transportation, so far as freight is concerned, has become completely overwhelmed, and is less efficient in proportion to the volume of business handled than was the freight transportation we had before the days of railroads, when canal boats and wagons drawn by horses were the only means of transportation.

Mr. Alexander gave figures to show that we are getting in the transportation of freight today an average of 61.61 miles per day, or 2.57 miles per hour, something over half a good hour's walk for a man, and less than the rate of canal boats and stage coaches. This, of course, does not mean that trains run as slowly as this, but it does mean that there is so much delay at initial and transfer points that the result is as given. One of the reasons for this, Mr. Alexander says, is the desire on the part of certain roads to hamper and embarrass rival roads, in the doing of which they seem willing to tie up freight indefinitely, to the great loss and injury of shippers. This subject is receiving increasing attention, and it is evident that shippers of freight generally are becoming intensely dissatisfied with present conditions. To say nothing of the specific losses that occur by reason of these delays, it is pointed out that the interest on the value of all goods in transit amounts to an enormous sum, and that this sum is largely augmented by the unreasonable delays that are taking place.

It can hardly be reasonably expected that the railroads should be able to expand their facilities rapidly enough to fully meet the present unprecedented demands upon them, and we suppose no one does expect them to do so. But there are distinct charges of intentional delays, and it is claimed that, instead of endeavoring to provide for the probable increase of business which has now come, some roads put off ordering new equipment to the last possible moment. Shippers exasperated by long delays can scarcely be expected to have much patience with such doings.

Toolmakers and Machinists

It ought to be remembered, perhaps, that there is about as much difference between toolmakers as there is between machinists. Every sort of man who can operate any kind of a machine tool is in these days calling himself a machinist, which is the name originally applied to a man who, with the drawings, castings and forgings placed in his hands, could build a machine and make a good job of it. Many of the present-day machinists would be very far from being able to do such a thing, and this is also true of many of the toolmakers. Many men who have merely turned and perhaps milled the flutes in a few reamers are in the habit of calling themselves toolmakers. But they are very different from one who is really able to do any kind of a tool-making job that may come along, including, if need be, the designing of tools and fixtures.

It is a little amusing to see the airs which are sometimes put on by so called toolmakers, who know almost nothing of

the business, over machinists who may happen to know pretty much everything about it. It should be understood that there are toolmakers and toolmakers, as well as machinists and machinists; and that many of the men who work outside the tool room and call themselves merely machinists are really far superior as mechanics to many others who work inside of tool rooms and call themselves toolmakers. The ideal toolmaker should first be a good machinist, and, though men have become very good toolmakers who never really learned the trade of a machinist, every such man would have been the better for the broader, groundwork training.

Exhibition of Safety Devices

Space is now being assigned for the exhibits of the First International Exposition of Safety Devices, to be held at the Museum of Natural History January 29, 1907. It is earnestly desired that all persons wishing to exhibit safety devices for wood- and metal-working machinery, stamping, grinding and polishing machines; safeguards for boilers, elevators, windlasses, cranes, hoisting machinery; textiles and building trades; safety lamps and explosives; quarrying and agriculture; chemical industries; safety from fire, railway and trolley accidents, should make application for space as soon as possible to W. H. Tolman, 287 Fourth avenue, New York.

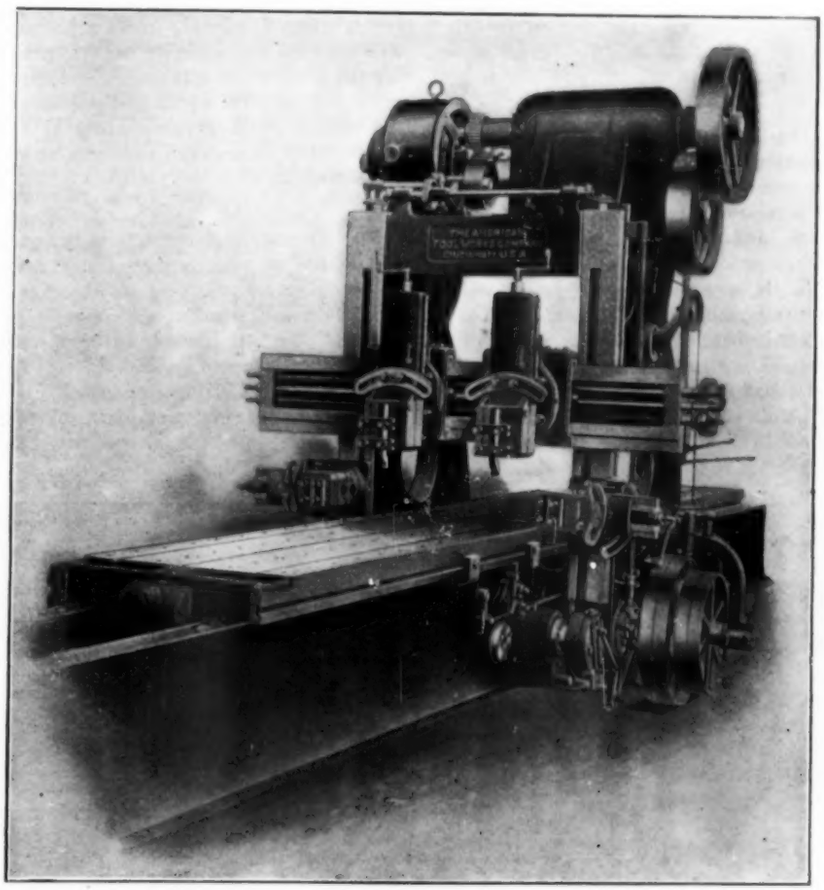
As the object of this exposition is to awaken the American public to the necessity of doing something to lessen the causes of accidents to life and labor, by means of a permanent Museum of Safety Devices where all problems of safeguarding life and limb may be studied in their working details, there will be no charge for space.

A plan for running cars to the summit of Mt. Blanc has been proposed by a Swiss engineer by the name of Feldmann. This would no doubt attract many tourists, though some holding views like those of Sir A. B. W. Kennedy, whose remarks on the disfiguration of Alpine scenery were contained in an article which we published recently, would perhaps prefer to depend on their own muscle and the less secure but more glorious alpenstock, This new scheme aims to avoid the construction of tunnels such as on the Jungfrau, by using, above the Glacier des Bossons, what is practicably a cable-way, two cables, one above another, being stretched on a suitable viaduct, and the car running on wheels between them. The power will be furnished by electric motors, not carried by the car, however, but serving to drive a cable which will pull the car up.

NEW TOOLS AND MACHINE SHOP APPLIANCES

VARIABLE-SPEED PLANER

The introduction of high-speed steels, and the increasing attention which is being paid to the fastest possible speeds for cutting metals, have led to the introduction of various devices for varying the cutting speed of planers, and as in this case it is necessary that the backing speed should remain constant, the problem with the planer is somewhat different from that which pertains to any other machine tool.



VARIABLE-SPEED, MOTOR-DRIVEN PLANER

Our illustration represents one of the latest devices for enabling the cutting speed of a planer to be varied to suit the circumstances of the work, and for maintaining a constant backing speed.

It consists of a speed box and motor, which are placed upon top of the housings, these being specially proportioned and adapted for the purpose. The mechanism is entirely inclosed so that it is dirt and dust proof. The case is oil-proof, and being supplied with oil, the mechanism runs in an oil bath. The gears, which are broad-faced and coarse pitched, run in oil and the pinions, which are of steel, are cut integrally with their shafts. The bearings are lined with phosphor-bronze bushings and supplied with ring oilers, and there are no friction devices, the drive being always positive. A safety interlocking device prevents the engaging of two conflicting speeds at the same time, and there is an index plate, which shows clearly how to obtain the desired speed.

One shaft runs directly through the feed-box and is driven at a constant speed. From it the belt leads to the backing pulleys of the planer; the other shaft is given four speeds by the movement of the levers, and from it the cutting speeds are derived. Fly-wheels are used at the end of the speed box instead of pulleys, in order to relieve the mechanism of the shock of reversing, and these wheels are carefully

balanced, so that their running does not produce any vibration or disturbance of the planer.

If for any reason it is desired to change this planer to a belt drive, all that is necessary is simply to put on a pulley at the left of the speed box. The belt driving this pulley is a constant-speed belt, and the changes of speed are then obtained in the same way as with the motor. *Per contra*, if the planer is first set up to be driven by a belt, it can at any time be changed to a motor drive by removing the pulley and attaching suitable constant-speed motor.

The same makers are also making a planer having two cutting speeds, these being obtained by means of a special counter-shaft, which is attached to the ceiling in the usual way, provided with self-oiling devices and otherwise arranged to require the least possible attention. The makers are the American Tool Works Company, 100-150 Culvert street, Cincinnati, Ohio.

A LARGE PUNCH PRESS

The illustrations show a large press for blanking and drawing such work as cream-separator bowls. The blanks for these are in some cases 12 inches diameter, 1 inch thick, and are drawn to a depth of 4 inches or over.

In the press shown the frame weighs 18,500 pounds. The area of the bed is 31x32 inches. The shaft is 9 inches diameter. The stroke of the slide is 12 inches. The maximum distance from the bed to the slide is 30 inches. The entire train of gears is made from steel castings with cut teeth. The large gear is 80 inches diamcter, 10 inches face and weighs 4500 pounds. The ratio of gearing is 25 to 1. The arrangement of the train of gears is shown in the rear view of the press at Fig. 2.

The fly-wheel is 50 inches diameter, 10 inches face, weighs 2500 pounds, and makes 250 revolutions per minute. The total hight of the press is 153 inches and it weighs over 41,000 pounds. The adjustment of the slide is 3 inches; it is regulated by a 3½-inch screw having a buttress thread so that the strains are taken on the flat side of the thread. The knockout is made to suit any hight of die by adjusting the set screw shown on the bracket on the left-hand upright in Fig. 1. The knockout can also be adjusted by the crank disk which is held to the shaft by a ratchet disk. The working of the press is controlled by an automatic jaw clutch which is positive in its action and will not click when thrown out. Depressing the foot treadle will cause the slide to make one complete stroke and stop on the top center. This press is made by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

A SHOP STOOL

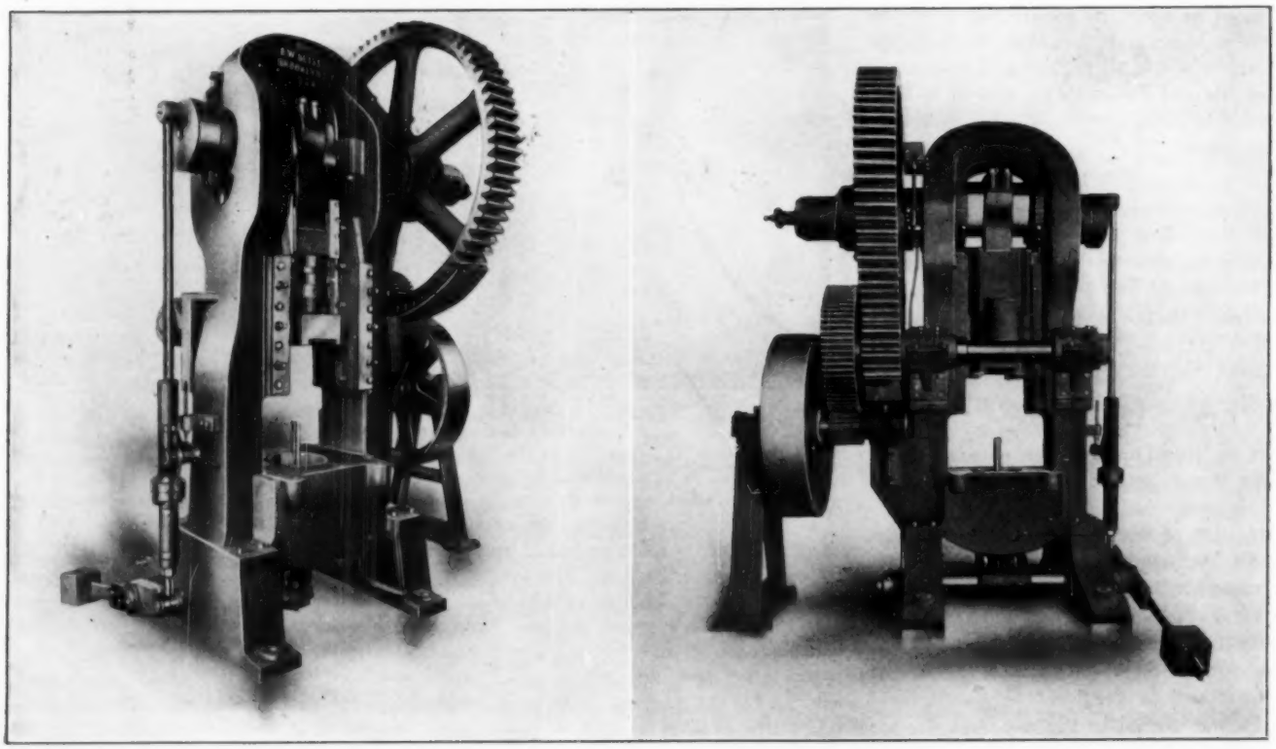
The illustration shows a stool designed for the use of machine shops, mills, manual training schools, etc., or wherever a stool that will stand rough usage is required. The seat is made of hard wood secured by screws to a metal frame. The frame has a projecting ring which fits a recess in the seat and prevents it splitting. The legs are of wrought-iron pipe, the rungs are of solid steel threaded right and left hand and bind the legs securely in position. These stools are made all

A SHOP STOOL

hights by the Manufacturing Equipment and Engineering Company, Boston, Mass.

GRINDSTONE TRUING DEVICE

The Cleveland Stone Company, of Cleveland, Ohio, is making a device for truing grindstones, which is actuated from the axis on which the stone is mounted, and which by means of a slide traverses a truing device across the face of the stone. This device is quickly applied to the grindstone frame, can be used with

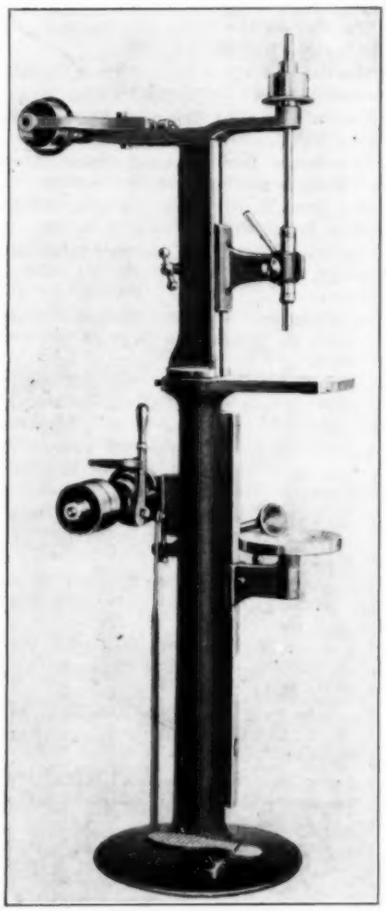


FIGS. 1 AND 2. FRONT AND REAR VIEWS OF THE PRESS

water so that no dust is distributed about the room, and makes it easy to keep the grindstone in first-class condition.

A SENSITIVE DRILL PRESS

The illustration shows a sensitive drill press, which will drill a ⅜-inch hole to the center of a 12-inch circle. The square table can be swung out of the way while the round table or center is in use. Both



A SENSITIVE DRILL PRESS

the top pulley bracket and the countershaft are provided with belt tighteners. The belt shifter is operated by foot lever, so that the operator has both hands at liberty to handle the work and feed. The spindle nose is reamed Morse No. 1 taper. The machine weighs 280 pounds. It is made by the Robertson Manufacturing Company, Buffalo, N. Y.

New Publications

"Practical Metal Turning." By Joseph G. Horner; 404 5½x8 inch pages, with 488 illustrations. The Norman W. Henley Publishing Company, New York. Price, $3.50.

The lathe and its work is a subject of perpetual interest, and this book is devoted exclusively to the lathe and its work. The book is of English origin and treats chiefly of English machinery and methods, but is not less useful and interesting to American readers on that account. Nearly all classes of lathe work are illustrated with a great variety of forms of chucks and chucking methods, a section being given to the turret lathe and its work. Measurements, grinding and tool holders receive attention, and there is a special chapter given to speeds, feeds, and tool steels, in which recent experiments on high-speed steel are drawn upon for data and rules for guidance.

"America's Amazing Advance." By Richard A. Edmonds. Baltimore: The *Manufacturers' Record*, 1906; 16 pages, 6x9 inches.

This pamphlet is a reprint of an article written for the December issue of the *Review of Reviews* by the editor of the *Manufacturers' Record*, and the general subject is well indicated by the title. It appears to be a successful attempt to put a great number of statistics into fairly readable form. It discusses the continual increase in the value of assets and of products in the various occupations of the American people, commencing with agriculture; the application of scientific methods to this art and the reclamation of millions of acres of land by irrigation, the improvement of methods of transportation, the mineral resources of the country, the leading position of the United States in the production of cotton and the advance of manufactures and foreign commerce.

"Switchboards." By William Baxter, Jr. 192 5½x8-inch pages, with 150 illustrations. The Derry-Collard Company, New York. Price, $1.50.

This volume contains a very complete and clear description of the functions and actions of switchboards. Beginning with a sketch of the origin and development of switchboards, it proceeds to take up the various classes, beginning with the simplest, direct current boards, and proceeding up to boards for 1-, 2- and 3-phase alternating currents, the mechanical construction as well as the electrical action being fully gone into. Part II is devoted to switches and circuit breakers, of which it describes the various types with their uses. The book is excellently printed and the engravings are new and of superior quality. It is exactly adapted to the needs of those who are assuming charge of electrical plants, whether large or small, is thoroughly good in every way and deserves a large sale.

"The Wm. J. Hammer Collection of Incandescent Electric Lamps." Eight 6x9-in. pages with one full-page illustration. The Franklin Institute, Philadelphia.

This pamphlet is the report of the Committee on Science and the Arts, of the Franklin Institute, on the historical collection of incandescent electric lamps made and exhibited at the St. Louis Exposition of 1904 by Wm. J. Hammer. Those of our readers who are interested in electrical developments will no doubt remember the remarkable collection of over 1000 incandescent electric lamps which formed Mr. Hammer's exhibit at St. Louis, and for which he received the grand prize. The collection illustrates every phase of the development of the incandescent lamp, including many early specimens which were never duplicated, and in the opinion of Prof. Elihu Thomson no similar collection could ever again be gotten together. The Franklin Institute committee characterizes it as "of unreplaceable and monumental character," and recommends for it the award by the institute of the Elliott Cresson medal. The ultimate disposition of the collection has not yet been determined, but we hope to see it presented to the American Institute of Electrical Engineers to be deposited in the museum, which we understand is to be established in the new Carnegie Engineering Building.

"Engineering in the United States." By Frank Foster. 115 6x9 inch pages. The University Press, Manchester, England. Price 1 shilling.

We have in this publication the results of one those studies of our industrial conditions and methods made by a citizen of another country, primarily for the information of his own countrymen, but often containing quite as much of interest to ourselves as to others. In the present case the book is a report by a holder of a Gartside scholarship and is based upon a 12 months' residence among us, part of which was spent as a workman in a manufacturing works and in a power station. In the present case, as in others, the interest to American readers is often the result of reading between the lines—the things which an author finds it worth while to point out at all, such for example, as the present author's statement that "in the Northern States it is quite rare to find a factory which is not thoroughly warmed in winter," as well as certain impressions which he finds it necessary to correct, often telling more than any amount of formal description and explanation. The fairmindedness of the author is apparent on almost every page and the results of his observations are of corresponding interest and value, although they are often unfavorable and nowhere can they be properly called profound. Thus he finds many of our manufactured products to be made on the "good-enough" principle, the workmanship being inferior to what would be expected in England—the absence of finish or polish being especially noticeable. He finds the use of labor-saving machinery to be somewhat more extended here than in England, but nevertheless concludes that "there is certainly not that enormous difference between the practice of the two countries, that is implied by many writers on the subject." He finds a greater degree of intercourse between employers and employees here than at home, but he found much less willingness on the part of employers to welcome suggestions by employees than

the writings of many English writers would indicate and he finds much less of the feeling of partnership between the two parties than exists in England. He remarks, as many others like him have remarked, on the universal belief here in popular education and gives a chapter to public schools, industrial and technical education. He finds less difference in the wages paid here and in England than is commonly believed—the rates being figured from the standpoint of purchasing power. Like the true Englishman he can see nothing good in protection and is disposed to ascribe such difference as exists in wage rates to the comparative smallness of our expenditures on naval and military armament. Of the output per man, he finds that "if the American workman does work harder than the English workmen the difference is not very much." He was surprised at the limited use of the piece-work system in even those shops that do practically nothing but repetition work. On the other hand, he finds that men are here paid according to their worth to a much larger extent than in England and this he believes to be one reason why piece work is less used here than there. The American work-shop manager, as well as the student of industrial conditions will find in the book an evening of "mighty interesting reading." It is printed on the superior quality of extremely light —not thin, but light—paper, which is so often seen in recent English books, but which is, we believe, not yet made here.

Foreign Orders for Machinery

Our consul, Albert Halstead, of Birmingham, in a recent issue of the Consular Reports, speaks of the inability of American tool builders to fill orders promptly, and the business they are losing in European markets by reason of this inability, remarking, with obvious truth, that where orders are filled by European builders, and the tools so supplied are found to work well, the buyers will naturally order similar machines when they are in the market for additional equipment. While this is all true enough, we see no possible remedy for it. It is obviously a pretty difficult matter to arrange for prompt deliveries in England and Germany when American customers are being put off from six to twelve months in the delivery of machines ordered.

Some of our leading American houses list orders as they are received, and conscientiously fill them in the order in which they are filed. It would seem that that is the only fair and businesslike way of doing, and that no discrimination should be made between foreign and home buyers. It certainly cannot be expected that the tool-builders of America can be prepared to meet such a demand as exists at present, without any delay whatever in filling orders. At the same time we believe that it is a mistake for our American builders to give the preference to home orders or to fill them at the expense of foreign customers. Every order, from whatever country it comes should be filled in its turn.

Personal

Asa. M. Mattice announces that, January 1, he will discontinue the business of consulting engineer, which he has conducted at 60 Wall street, this city, to undertake the management of the works of the Walworth Manufacturing Company, South Boston, Mass.

E. T. Gorham, who for about seven years has been superintendent of the Oliver Machinery Company's plant, in Grand Rapids, Mich., has become a stockholder in the Wilmarth & Morman Company, of that place, and will be the shop manager after January 1. C. H. Rhodes, who has been manager of the Grand Rapids branch office of McDowell, Stocker & Co., of Chicago, will take the position of sales manager of the above named company.

Obituary

Captain Alfred Bruce Canaga, U. S. N., head of the steam-engineering department at the Boston Navy Yard, dropped dead while on his way from the steam engineering building to his home in the yard, December 24. Captain Canaga was born in Ohio, in 1850, and entered the Naval Academy as a cadet engineer in 1872. He was graduated in 1874 and his first sea duty was on the flagship "Worcester" of the home station, where he served until April, 1875. In the Spanish war he was in the bureau of steam engineering of the navy department and next was on duty at the Cavite naval station.

Business Items

The Warner & Swasey Company, of Cleveland, Ohio, has opened a New York office in the Singer building, at 149 Broadway, in charge of H. L. Kinsky. This will enable them to give better service to their Eastern customers.

The Atlas Engine Works, of Indianapolis, has opened a branch office in Louisville, Ky., located at 58 Kenyon building. It is in charge of G. A. House, who recently resigned his connection with the Erie City Iron Works at Detroit.

The American Shipbuilding Company, of Cleveland, recently placed an order with the Atlas Engine Works, of Indianapolis, for two large tandem compound four-valve splash oiling engines of the latest type. They are to be installed in the company's plant at Lorain, Ohio.

Riehle Bros. Testing Machine Company, Philadelphia, Penn., has been awarded the contract by the Bureau of Surveys of the city of Philadelphia for a compression testing machine of 1,000,000 pounds capacity. It is to be installed in their testing laboratory for making compression tests of building material, concrete, etc.

The Abrasive Material Company, of Philadelphia, Penn., is doing a large foreign business. A large order, amounting to seven or eight hundred emery wheels of different sizes, weighing four or five tons, was recently shipped to Italy. Other orders have been received from England, Germany, Austria, Japan and Siberia.

Manufacturers

The D. and W. Fuse Company, Providence, R. I., will erect a new foundry.

The Coöperative Plato Ice Company, Baltimore, Md., will erect a plant.

The Reading (Pa.) Steel Casting Company is to erect a new foundry biulding.

The Chicago (Ill.) Reduction Company will build a new factory to cost $15,000.

The Zeman Iron Works Company, Cleveland, Ohio, is putting up a new factory.

The Hires-Turner Glass Company, Philadelphia, Penn., will build a new factory.

The Murphy Foundry and Manufacturing Company, Asbury Park, N. J., will build an addition.

Bigney & Co., jewelers, Attleboro, Mass., will erect an addition as large as the present plant.

The Illinois Central Railroad will enlarge its machine and repair shops at McComb City, Mich.

The city of Ashland, Wis., will vote on the question of a municipal electric light and power plant.

H. C. Carroll & Sons, Philadelphia, Penn., will erect a brick manufacturing plant, to cost $17,000.

The American Fire Proof Sanitary Hollow Brick Company, Philadelphia, Penn., will put up a new plant.

The Hartford (Conn.) Machine Screw Company is planning to build a four-story addition to its plant.

The New York State Steel Company, Buffalo, N. Y., has filed plans for a pump-house and machine shop.

A power plant is to be erected at Nanticoke for the American Pipe Manufacturing Company, of Philadelphia, Penn.

The General Electric Company, Schenectady, N. Y., will build an addition, 800x150 feet, to its turbine department.

The Penn Reduction Company, Philadelphia, Penn., will rebuild its plant which was destroyed by fire a short time ago.

The Great Northern Power Company, Duluth, Minn., is negotiating for a site in Superior, Wis., on which to build a plant.

The Elgin A. Simonds Company, Syracuse, N. Y., has commenced the construction of a new chair factory to cost about $70,000.

The Danbury (Conn.) & Bethel Gas and Electric Light Company is planning to make extensive enlargements and improvements.

The Hennessey (Okla.) Electric Light, Ice and Power Company has been organized and will build a plant. Fred Ehler, president.

A franchise for a gas plant at Boyne City, Mich., has been given to W. H. Selkirk, of Boyne City, and O. S. Heyden, of Petoskey.

J. T. Bebean, of Mount Sicker, B. C., has under consideration the matter of installing an electric-light plant at the Brenton Hotel.

The capacity of the municipal light and power plant at Marquette, Mich., will be increased by the addition of another powerhouse.

The Merchants Cold Storage and Ice Manufacturing Company, Richmond, Va., will erect a new boiler house at a cost of $10,000.

The Polar Wave Ice and Fuel Company, St. Louis, Mo., is preparing to erect a new

ice plant which, with machinery, will cost $100,000.

The Brooklyn Borough Gas Company has purchased a site on Coney Island, N. Y., on which it is said a $1,000,000 gas plant will be erected.

The Winchester Repeating Arms Company, New Haven, Conn., will erect two additions for use in connection with the woodworking department.

The Orange County Traction Company, Newburgh, N. Y., will erect a new building to be used as a machine and repair shop, as well as car barn.

The Van Auken-Clevaue Company, of Yonkers, N. Y., manufacturing steam specialties and marine engines, will erect a factory in Bridgeport, Conn.

The canning factory of the J. T. Polk Company, Greenwood, Ind., was destroyed by fire. Loss is estimated at $225,000. The plant will be rebuilt.

The Reading Railway Company is planning three additions to the plant at Reading, Penn., which will include a repair shop, paint shop and round house,

The box factory of Bell & Coggeshall, Louisville, Ky., recently destroyed by fire, is being rebuilt at a cost of $100,000. The machinery will be operated by electricity.

Plans for improvements are contemplated by the Scranton (Penn.) Railway Company involving a expenditure of $585,000. These will include a new power house.

The Morgan Spring Company, of Worcester, Mass., will erect an open-hearth plant at its branch in Struthers, Ohio, to cost over a million dollars; also a billet and bar mill.

The Atlantic Insulated Wire and Cable Company, whose leased quarters in Stamford, Conn., were destroyed by fire, has awarded contract for the erection of a new plant.

The United States Steel Company will build a new 14-inch and 22-inch structural mill at Clairton, Penn., and a 1000-kilowatt generator with gas engine will be installed.

The Columbus (Ga.) Power Company has a project for developing over 200,000 horsepower on the Chattahoochee river, which will involve an outlay of several million dollars.

The Central Colorado Power Company, capitalized at $22,500,000, has filed articles of incorporation in the office of the county clerk at Pueblo, Colo., the object of the company being to secure and operate water rights for power, heating and lighting purposes in 26 counties. The head office will be at Colorado Springs. Myron T. Herrick, former governor of Ohio, is one of the directors.

Catalogs

Jacobs Mfg. Co., Hartford, Conn. Catalog of Jacobs improved drill chuck. Illustrated, 6x9 inches.

The E. H. Mumford Co., Seventeenth and Callowhill streets, Philadelphia, Penn. Catalog of molding machines. Illustrated, 6x9 inches, 32 pages, paper.

Chas. Leonhardt, New Ulm, Minn. Special Circular No. 12, illustrating and describing Leonhardt's patent adjustable power hammer. Illustrated, 6½x10 inches, 10 pages.

Reinforced Brazing and Machine Co., 1109 Arrott building, Pittsburg, Pa. Booklet describing Richardson method of brazing and reinforcing cast-iron castings. Illustrated, 6x9 inches, paper.

American Diamond Rock Drill Co., 95 Liberty street, New York. Catalog No. 26, which describes diamond-pointed core drills with records of work done. Illustrated, 6x9 inches, 88 pages, paper.

Joseph Dixon Crucible Co., Jersey City, N. J. Booklet describing Dixon's graphite pipe-joint compound. 3½x6 inches, 12 pages, paper. Booklet, entitled "The Proper Care of Belts." 3½x6½ inches, 12 pages, paper.

The John Bertram & Sons Co., Ltd., Dundas, Ont. Catalog of machine tools, including milling machines, lathes, drilling machines, slotting machines, boring and turning mills, shaping machines, railway machinery, etc. This is a handsome catalog, 9½x12 inches, containing 256 pages, very fine half-tone illustrations, and bound in cloth.

Yale & Towne Manufacturing Company, 9 Murray street, New York. Booklet entitled "Suggestions for Selling Yale Padlocks," which ought to be of value to those interested. Illustrated, 3½x7½ inches, 31 pages, paper. Booklet, "A Book about Padlocks," which illustrates a great many uses to which padlocks can be put. 3½x6 inches,

General Electric Company, Schenectady, N. Y. Bulletin No. 4468. Electric Mine Locomotives. Illustrated, 8x10½ inches, 53 pages. Bulletin No. 4466. Remote Control Field Rheostats. Illustrated, 8x10½ inches, 6 pages. Bulletin No. 4470. The Electric Motor in Saw-Mill Work. Illustrated, 8x10½ inches, 8 pages. Bulletin No. 4473. The GE-81 Railway Motor. Illustrated, 8x10½ inches, 14 pages.

Geo. Nash & Co., 224-226 Pearl street, New York. Catalog C, which tells in a general way of the various things handled by this company, including tool steels, springs, wire, etc. Several tables are included. 3½x6 inches, 45 pages, paper. Booklet, entitled "Capital High Speed Steel—Its Treatment and Uses." Booklet, "Hints to Practical Users of Tool Steel." This contains a good deal of information which ought to be useful to those interested.

Ingersoll-Rand Co., 11 Broadway, New York. Leaflet, Form 45-A, calling attention to Ingersoll-Rand rock drills. Illustrated, 3½x5½ inches, paper. Catalog No. 36. This contains descriptions of the different types of Ingersoll-Sergeant air and gas compressors. Two engineering articles—one on "Compound Air Compression" and one on "Some Important Elements of Economy in the Straight Line and Duplex Types of Compound Air Compressors"—are included, as well as some new tables and other valuable information on compressed air. Illustrated, 6x9 inches, 184 pages, paper.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith Co., Columbia, Pa.

Cox Computers. 75 Broad St., New York.

Wire and sheet-metal-working machinery and tools. Emmons Collins, Chicago, Ill.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Steel case-hardened by modern methods. Boston Gear Works, Norfolk Downs, Mass.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Runnerless slide rules. New method of operating. F.F. Nickel, 27 Winans St., E. Orange, N.J.

Automatic machines designed and built. Geo. M. Mayer, M.E., 1131 Monadnock Bldg., Chicago, Ill.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, New York.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Medium-weight specialties to build, or will buy or pay royalty for good patented machine or tool. Box 424, AMER. MACHINIST.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACH.

Special machinery to order. Catalog of small engines and boilers and engine castings 10c. Sipp Elec. & Mach. Co., Paterson, N. J.

Estimates given on machine work, patterns and designing in all branches. Address Greenfield Steam Engine Works, Harrison, New Jersey.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Salesmen—Men with technical experience wanted by firms we serve; high-grade propositions; salaries right to the right men; write us today. Hapgoods, 305 Broadway, N. Y.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

Want first-class machine shop to estimate on special machine, large and medium work. Total weight about fifteen tons. Vicinity Boston, Philadelphia. Box 475, AMER. MACH.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

Dec. 26, 1906.

The annual meeting of the stockholders of The Derry-Collard Co. for the election of officers and such other business as may properly come before the meeting will be held at the offices of the company, 109 Liberty street, January 14, 1907, at 5 P. M.

LOUIS ROUILLION, Secy.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company in the Hallenbeck Building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Monday, January 14, 1907, at 12 o'clock noon.

Dated, New York City, Dec. 17, 1906.

F. R. LOW, Secretary.

Business Opportunities

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Astall Iron Works, machine-shop plant, established 40 years. Jesse Astall, Galveston, Texas.

United States Patent 751,253 for sale. Cannot devote time to manufacture. Address the inventor at 95 Liberty street, New York.

For Sale—Two 20-ton swing cranes, about 30 feet radius and 23 feet lift; hoisting, lowering and trolley movement by both power and hand drive. These cranes may be seen in use at Southwark Foundry & Machine Co., Fifth St. and Washington Ave., Philadelphia, or drawing will be sent on application.

For Sale—Two second-hand cupolas in first-class condition; shells 72"—82" in diameter and about 40 feet high. Box 333, AM. MACH.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Factory manager—Mechanical engineer with high-class executive and business ability desires position as manager of manufacturing department of any first-class concern in the machinery line; am married, 33 years of age, and have a family; have 12 years' experience in all departments of the manufacturing business and can submit excellent record; can develop new articles, make tools, dies and jigs, etc., handle men, organize shop systems and do everything necessary to produce results; will consider only a first-class proposition, either from an established concern or from capital desiring to enter the manufacturing business; references required and given, and details gone into at interview only. Address "F. H. S.," AMERICAN MACHINIST.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Position of responsibility by man with nine years' shop and drafting-room experience; technical education. Address Box 477, AMERICAN MACHINIST.

Wanted—Position as foundry foreman with some reliable firm; sober man, well up in machinery castings and cupola practice and mixing iron by analysis. Address Box 462, AMERICAN MACHINIST.

All-around tool and diemaker—15 years' experience on high-grade interchangeable work, American, age 38, married—would like position as foreman toolmaker. Box 450, AMERICAN MACHINIST.

MICHIGAN

Superintendent wishes to make a change; experienced in the commercial manufacturing of both small and medium machinery with the interchangeable system; a systematizer and cost reducer; have held the following positions: toolmaker, tool designer, foreman and master mechanic; willing to go anywhere; New England preferred. Address Box 403, AMERICAN MACHINIST.

NEW JERSEY

Tool designer (29), experienced on jigs, tools, dies and special machinery for interchangeable manufacturing, desires position. Box 485, AMERICAN MACHINIST.

NEW YORK

Position with concern manufacturing, or going to manufacture, gas or oil engines, by experienced mechanical engineer. Box 482, AMERICAN MACHINIST.

Thoroughly practical shopman — A-1 mechanical, technical and business training, organizer, systematizer and able executive—desires high-grade position. Box 484, AM. M.

General foreman and master mechanic, age 37, successful manufacturing economically and erecting high-grade duplicate and special machinery; natural executive. Box 474, AMERICAN MACHINIST.

Wanted—Position in New York City or vicinity as purchasing agent by graduated mechanical engineer, who wishes to spend half of each day on this occupation. Box 463, AMERICAN MACHINIST.

Superintendent desires position; now holding in place of responsibility and importance, but change of locality desirable; highest references as to mechanical and business ability and character. Address Box 488, AM. MACH.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

PENNSYLVANIA

Position as superintendent of foundry and pattern shop wanted by a married man, aged 31; thirteen years' practical experience; present position not satisfactory. Box 476, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—Experienced toolmakers on gages, fixtures and dies. Address, giving particulars of experience and wages desired, Ross Rifle Co., Quebec, Canada.

CONNECTICUT

Wanted—Good all-around machinists familiar with heavy work; steady work and good wages. Apply at once, Farrel Foundry & Machine Co., Ansonia, Conn.

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

IOWA

Wanted—High-class mechanic to take charge of tool department of about 15 men in a duplicate-part factory in a small Western city; state experience and length of service with previous employer. Box 411, AMER. MACH.

MICHIGAN

Foreman die and tool department—Wanted, a man capable of managing this department in a large factory in southern Michigan, manufacturing steel ranges, summer cook stoves, etc.; must be able to design and make all classes of forming, drawing, perforating and punching dies and special power tools; will also act as master mechanic for entire plant; successful applicant must show actual experience as foreman in this class of work; liberal salary for right man. Address Box 455, AMERICAN MACHINIST.

MISSOURI

Wanted — First-class assemblers; prefer those having had experience on adding machines or typewriters; give references. Universal Adding Machine Co., St. Louis, Mo.

Wanted—Machinists, electricians, engineers and firemen, do you want to "get wise?" Send for 52-page pamphlet containing questions asked by different Examining Boards; sent free. Geo. A. Zeller Book Co., 53 South 4th street, St. Louis, Mo.

Experienced superintendent, familiar with general sheet-metal work and fire-proof windows; take full charge of factory; permanent position for first-class man; state experience and salary wanted. Address H. W., AMERICAN MACHINIST.

NEW JERSEY

Wanted—Lathe, planer, vise and machine hands; good wages for first-class men. The Standard Motor Construction Co., 180 Whiton street, Jersey City, N. J.

Wanted—Toolroom foreman; must be familiar with building of jigs, special fixtures and machinery; modern equipment; location, Newark, N. J. Box 471, AMERICAN MACH.

Wanted—To contract for a large part of our duplicate engine parts with responsible firms, equipped with modern machinery. The Standard Motor Const'n Co., 180 Whiton St., Jersey City, N. J.

Wanted — Foreman grinding department, operating mostly Landis grinders; first-class equipment, modern shop, Newark, N. J.; state experience and wages expected. Box 452, AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

Foreman over 20 machinists, making light machinery and electrical goods in plant employing 90 men; live city in Jersey, 20 miles from New York; state experience and salary. Box 451, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—Party to take charge inspection room of company manufacturing small machinery parts; previous experience preferred, but not required; state particulars; location, Newark, N. J. Box 481, AMER. MACHINIST.

Draftsmen—Large works requires competent men with experience on general engineering and construction work; preferably those who have worked on heavy special machinery, power plants, mill buildings, etc.; applications must state age, qualifications, initial salary and references. Box 487, AM. MACH.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

Wanted — Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Expert brass-foundry foreman on fine castings, false cores, etc.; must know his business thoroughly, be up-to-date and a good executive. Box 486, AMERICAN MACHINIST.

Wanted in January—Competent mechanics capable of lining up heavy machinery and shafting; applicants will please state wages desired. Apply A. A. P. C. W., Alsen, Greene Co., New York.

Several mechanical draftsmen wanted; must have had at least 4 years' actual experience; good salaries to good men; give particulars; location New York City. Box 460, AMERICAN MACHINIST.

Foreman wanted—A man who is a practical mechanic and is capable of handling young help on small interchangeable clock work; good wages, with chance for advancement to the right man. Box 469, AMER. MACHINIST.

Wanted—Competent superintendent for a manufacturing plant within 50 miles of New York City; please give full information as to previous experience, together with references, amount of salary, etc. Address "A. D.," AMERICAN MACHINIST.

OHIO

Wanted — First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 388, AMERICAN MACHINIST.

A man with both steam engineering and commercial experience, preferably one who has given special attention to steam work, to take charge of sales of a line of steam specialties for a large manufacturing concern in the central West. In responding, give age, previous experience, present employment, references and salary desired. Address Box 483, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Hammerman for light drop-forge work. Box 478, AMERICAN MACHINIST.

Wanted—Man who understands drop-forge work, both hammers and dies. Box 479, AMERICAN MACHINIST.

Wanted—Machinist to work on fine tools, capable of getting out new tools; good opportunity to right man. F. G. Smith Co., Columbia, Pa.

Wanted — Experienced mechanical draftsmen for general machinery; men experienced in heavy pumping machinery preferred; location, eastern Pennsylvania. Address "Mechanical," AMERICAN MACHINIST.

Operator for 60" vertical spindle milling planer (Ingersoll); man experienced on a machine of this class; on general work preferred; state age, experience, wages expected, etc. Adress "Preble," Allegheny, Pa.

Mechanical draftsmen wanted for detail work with large mining company in western Pennsylvania; applicants must state age, experience, salary expected, and date for entering position. Box 472, AMER. MACHINIST.

Wanted—First-class machinists for floor work; must be capable of erecting machines outside the shop and demonstrating; state actual experience in such work. Apply to Stoever Foundry and Manufacturing Co., Myerstown, Pa.

Technical and experienced man wanted to fill position of chief mechanical draftsman with a large mining company in western Pennsylvania; state age, experience, salary expected and date for entering position. Box 473, AMERICAN MACHINIST.

Wanted — An experienced mechanic with good address who understands thoroughly turrets, automatic machines, etc., to represent a well known house with an established trade, calling upon the iron and steel plants in western Pennsylvania and Ohio; state experience, age and salary expected at start. Box 480, AMERICAN MACHINIST.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery, or printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

WEST OF MISSISSIPPI

The J. Geo. Leyner Eng. Wks. Co., of Littleton, Colo., are increasing their plant and are in need of good mechanics, machinists, blacksmiths and sheet-iron workers. Littleton is a suburb of Denver, where cost of living is reasonable; superb climate the year round. Address above.

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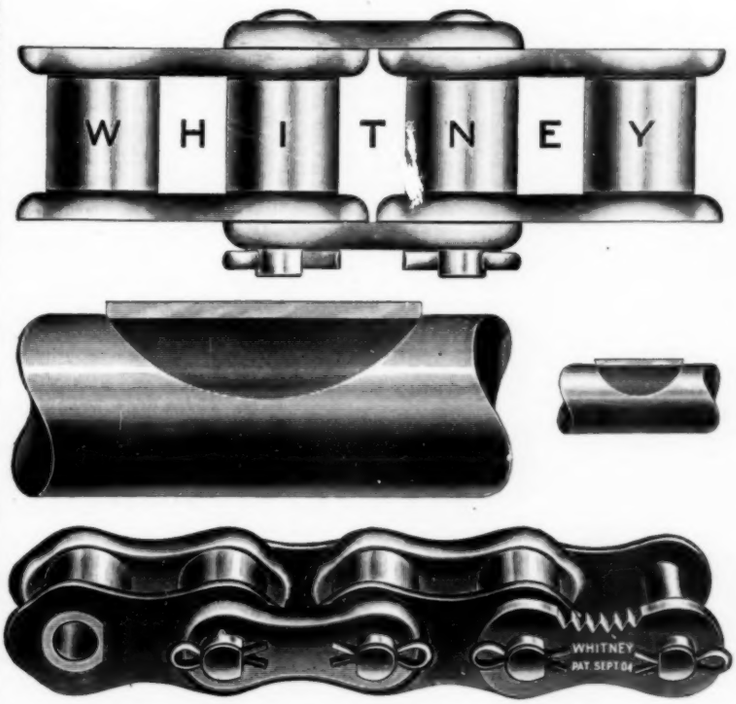

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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Leard, W. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., New Center, Mass.

Countershafts—*Continued.*
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., New Center, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., New Center, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Byram & Co., Inc., Detroit, Mich.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nichols, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Leard, W. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuue, Iowa.
Becker - Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-Off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Globe Machine & Stamping Co., Cleveland, O.
Kent & Co., Edw. R., Chicago, Ill.
Swaine Co., Fred J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, O.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press
Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Economy Drawing Table Co., Toledo, Ohio.

Drawing Materials
American Tracing Cloth Co., New York.
Derry-Collard Co., New York.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

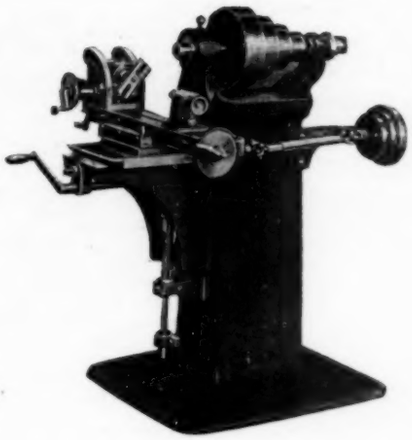
Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B F., Rockford, Ill.

BROWN & SHARPE MFG. CO.,

Providence, R. I., U. S. A.



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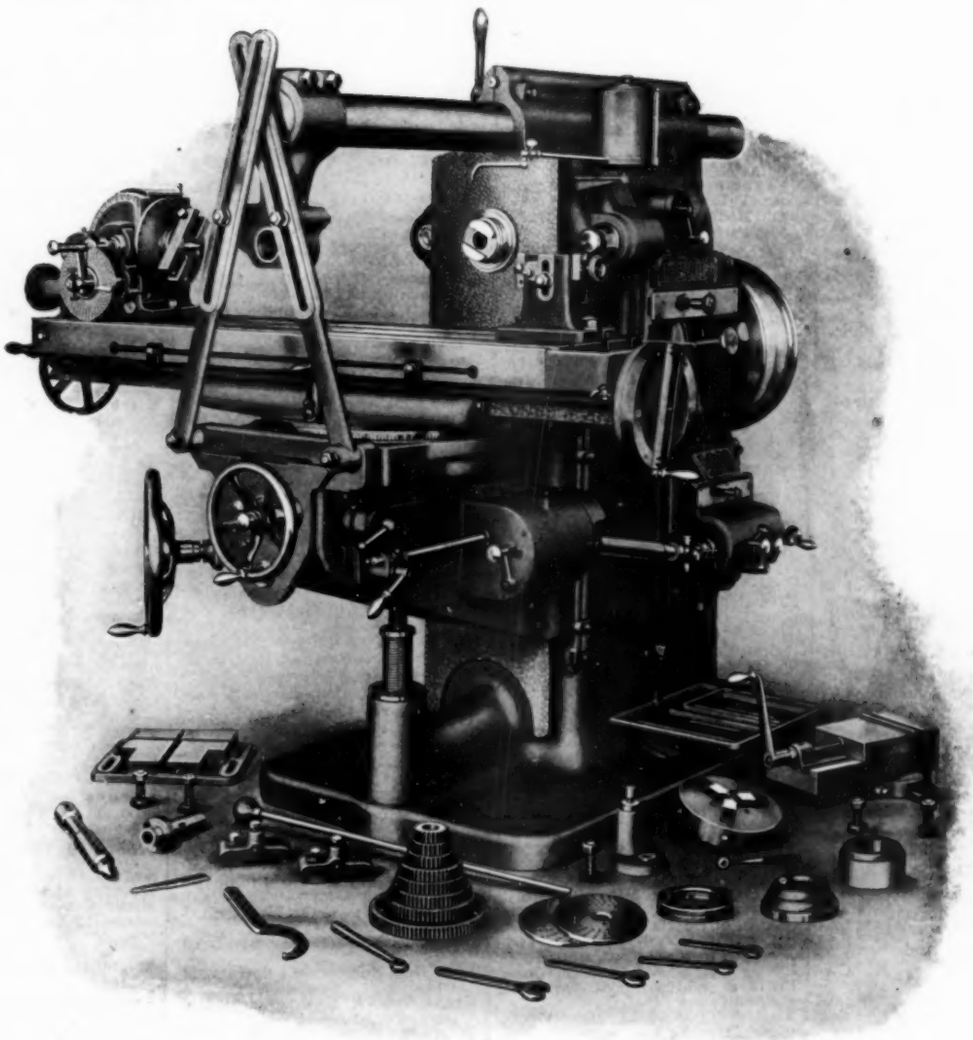
Brown & Sharpe Universal Milling Machines.

Standard for More Than 40 Years.



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See page 229

Drilling Machines, Bench —*Continued.*
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt & Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N.Y.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fichburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
National Separator & Machine Co., Concord, N. H.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Burke Machinery Co., Cleveland, Ohio.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote, Burt & Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Mach. Co., Rockford, Ill.
Murchey Machine & Tool Co., Detroit, Mich.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Robertson Mfg. Co., Buffalo, N.Y.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Clark, Jr., & Co., Jas., Louisville, Ky.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.
Morse, Williams & Co., Philadelphia, Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Heald Machine Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room
Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting, and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker - Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene
Atlas Engine Works, Indianapolis, Ind.
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.

Engines, Gas and Gasolene —*Continued.*
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Atlas Engine Works, Indianapolis, Ind.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Bormay & Co., New York.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., Wm., Wilkesbarre, Pa.

Extinguishers, Fire
Badger & Sons Co., E. B., Boston, Mass.

Fans, Electric
Boston Blower Co., Hyde Park, Mass.
Crocker - Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Crocker - Wheeler Co., Ampere, N. J.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Heller Bros. Co., Newark, N. J.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filler, Iron
Clark Cast Steel Co., Shelton, Ct.
Felton, Sibley & Co., Phila., Pa.

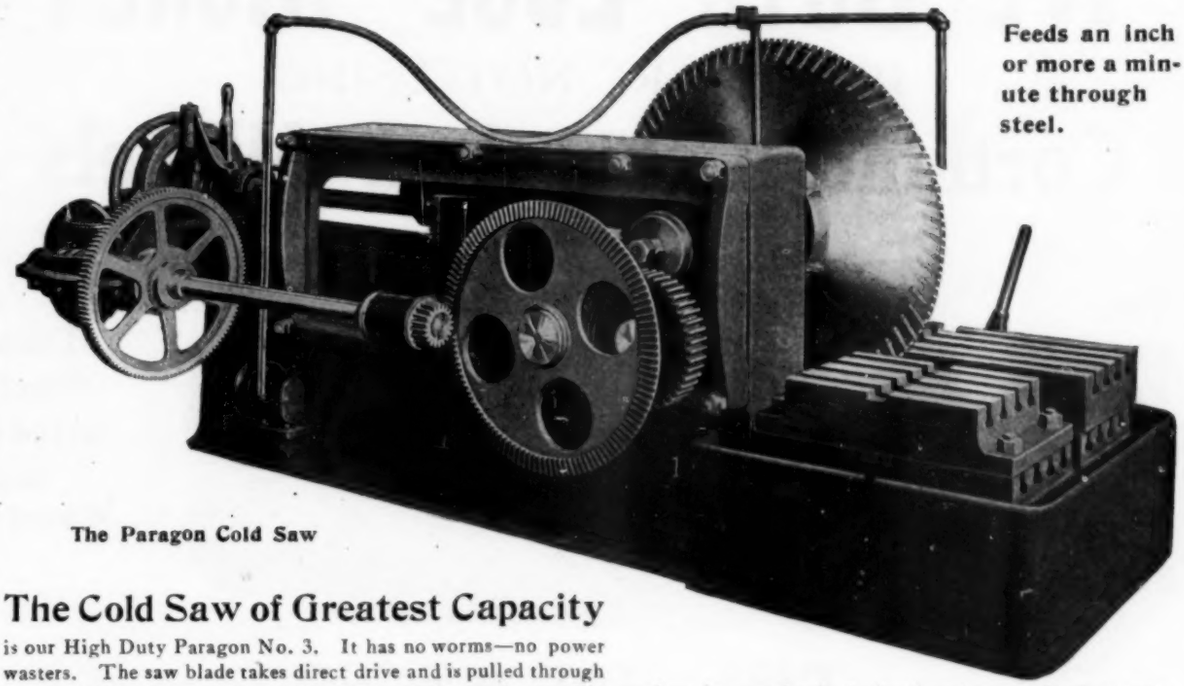
Filing Machines
Cochrane-Bly Co., Rochester, N.Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Sheldon, Conn.
Wyman & Gordon Co., Worcester, Mass.

Begin The New Year's Economy With These Dividend Increasers.



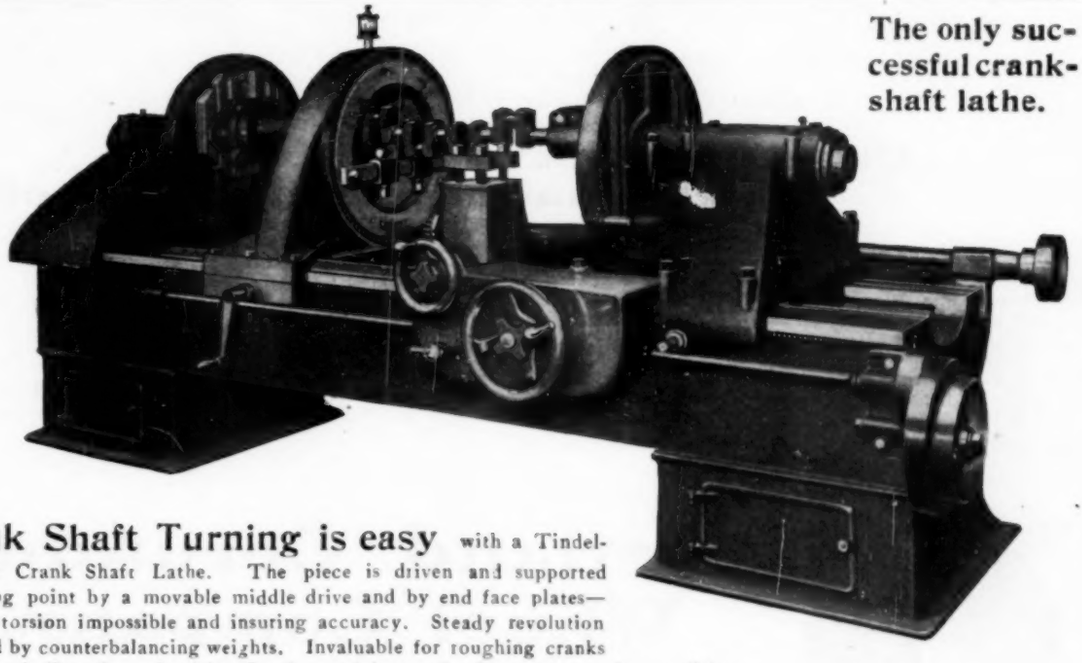
Feeds an inch or more a minute through steel.

The Paragon Cold Saw

The Cold Saw of Greatest Capacity

is our High Duty Paragon No. 3. It has no worms—no power wasters. The saw blade takes direct drive and is pulled through cut. Rigidity is insured by table and frame of one piece. The carriage is completely inclosed and runs in an oil bath. The saw can't buckle. Teeth are automatically cooled. It will reduce your expenses—send for proof.

High Duty Saw and Tool Co., Eddystone, Penna.



The only successful crank-shaft lathe.

Crank Shaft Turning is easy

with a Tindel-Albrecht Crank Shaft Lathe. The piece is driven and supported at cutting point by a movable middle drive and by end face plates—making torsion impossible and insuring accuracy. Steady revolution is secured by counterbalancing weights. Invaluable for roughing cranks down to grinding size. Send for Catalog and learn of other money-saving qualities.

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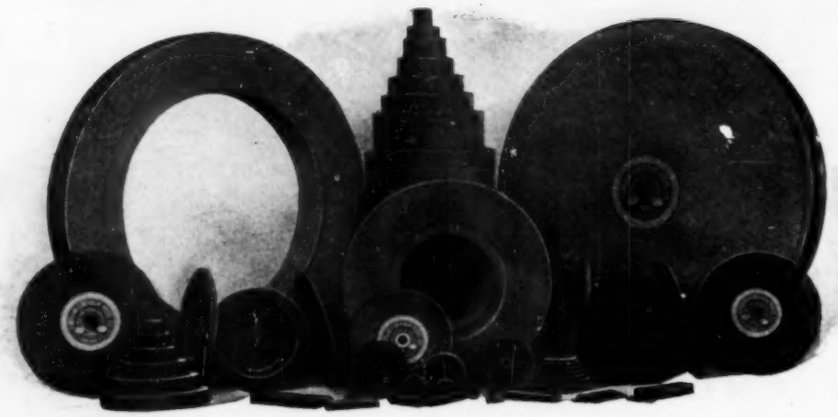
IF YOU ARE NOT USING

Cortland Corundum Wheels

They Cut Faster Last Longer Are Safer



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THE REASON.

They are made of PURE CORUNDUM, the hardest material of the Mineral Kingdom, the Diamond alone excepted (the Ruby and the Sapphire are Corundum in perfect highly colored crystals). They are made by a secret process that gives the highest cutting efficiency, durability and safety yet attained in Grinding Wheels.

They Cut rather than Grind!
They are uniform—each like the other!

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Lilly & Stalnaker, Indianapolis, Ind.
Standard Scale & Supply Co., Pittsburg, Pa.
Albert Griffiths Saw Co., Boston, Mass.
Minneapolis Iron Store Co., Minneapolis, Minn.
Nicols-Dean & Gregg, St. Paul, Minn.
The Richards & Conover Hardware Co., Kansas City, Mo.
Iowa Machinery & Supply Co., Des Moines, Ia.
The Tennessee Mill Supply Co., Knoxville, Tenn.
Pidgeon-Thomas Co., Memphis, Tenn.
Southern Mill, Mine and Railway Supply Co., Nashville, Tenn.
Eagle Saw Co., Chattanooga, Tenn.
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The Fairbanks Co., Hartford, Conn
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AIR-COOLED GAS-ENGINE CYLINDER CONSTRUCTION

BY HUGH DOLNAR

The gas engine and the steam engine stand at the two extremes of heat motors. The steam engine begins with cold water and fire, and water is very reluctant to yield to fire and absorbs a lot of heat before it begins to turn to steam, and with the steam engine everything has to be kept as hot as can be, all the way through, to keep the steam from going back to water again. With the gas engine things are the other way about with a vengeance. Fire and iron agree perfectly, and when we put the furnace in the cylinder and burn our motor fuel between the piston and the cylinder head the very first power production requirement, after lighting the fire, is cooling things; first the valves, cylinder and piston, and next the exhaust. The problem is to get rid of heat, all around, not to save heat everywhere, as we try to do in the steam engine.

When we want to cool things we plunge them into cold water, or else we blow air on them, and the gas engine is no exception to this every-day cooling practice.

THE FIRST AMERICAN GAS ENGINE

The first American gas-engine patent, No. 3597, isued May 25, 1844, was granted to Stuart Perry, Newport, New York, for his two-cycle double-acting, air-cooled, gas engine. Perry says at the end of his curious specification: "I have found that the main cylinder by the continued operation of the machine is liable to become too highly heated. It is proper, therefore, to adopt means to prevent this, which may be effected in various ways. That which I prefer is to inclose the cylinder and its immediate appendages in a case, through which cold air may be blown by means of a rotary fan or other blowing apparatus, which may be operated by the engine in any convenient manner."

Probably Perry did not have much luck with his gas engine, as I have never yet been able to find any trace of his work, though he appears to have built several gas engines in New York City, 1843-47. It will be noted that this first patent to Perry throws air cooling of gas-engine cylinders wide open to the public.

WATER-COOLED CYLINDERS

Perry continued his work with a stout heart, convinced that he had found a heat motor far superior to the steam engine, which we are just now beginning to discover is true, and in a second specification, U. S. patent No. 4800, issued October 7, 1846, he says, speaking of the fire in the cylinder: "It has been found, however, that the heat thus generated and communicated to the cylinder and to the other parts of this engine, is a serious practical difficulty," and so on. This second time trying Perry took water as his surplus heat remover. His specification goes on to say: "My first improvement consists in surrounding the cylinder of the engine with water to carry off the heat generated by the explosion of the gases, and keep it at a sufficiently low temperature for the efficient action of the engine, and at the same time, in certain cases to employ this surrounding water as a water jacket for the retort which generates the inflammable gas," and so on.

HOT-TUBE IGNITION

It is interesting to note that Perry, who undoubtedly had a heart-breaking time with his new and best heat engine—hard, indeed, is the lot of the man who knows things too soon and too hard!—not only invented air-cooling and water-cooling of gas-engine cylinders and patented these inventions, but also invented hot-tube ignition, which was re-invented and patented many years later by Gottlieb Daimler, who gained fame and renown thereby, and became known as the "father of the automobile," simply because he did what Perry patented a generation before him.

Perry's fourth claim says, patent 4800, October 7, 1846, "4. The method of inflaming the explosive mixture in the cylinder or in the induction passages by means of heated platina or other metal having like properties, and provided with a valve or valves by which the heated surface can be separated from the explosive mixture." This separation was made so that the hot-tube ignition time could be regulated, which Daimler did not attempt.

To come back to cylinder cooling, Perry's second method, the water jacket, is employed exclusively for small gas engines in Europe, and is the fashionable method of cylinder cooling in America, though air-cooling is largely used, with entire success, in many American car-motors, and is far better than water-cooling in every particular, and must presently become ruling practice.

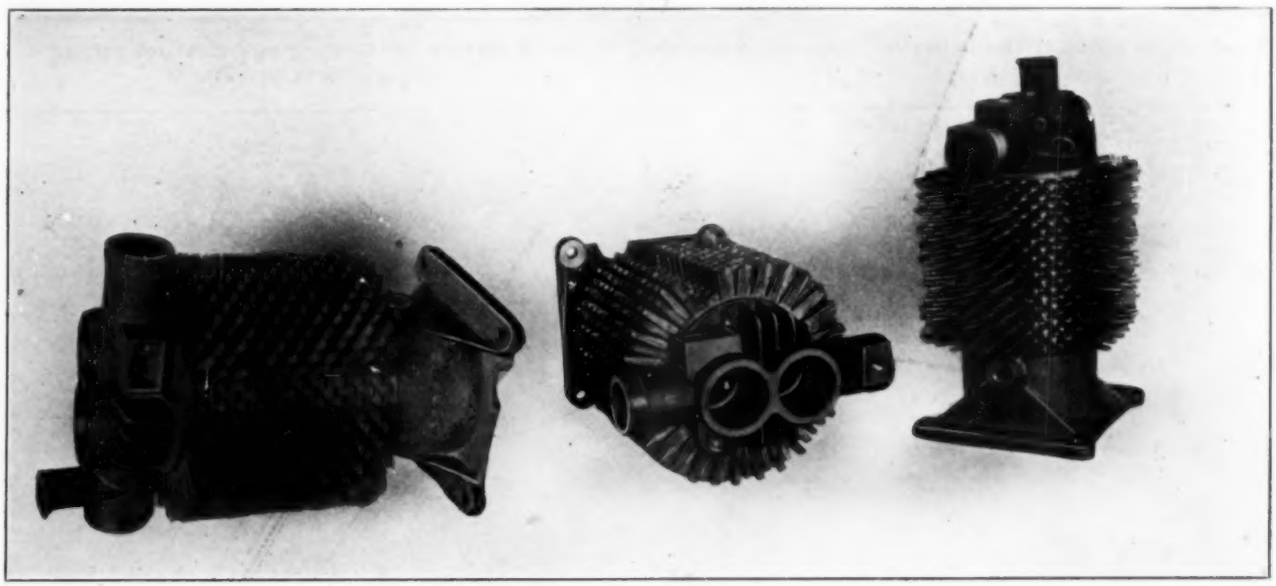


FIG. 1. CORBIN AIR-COOLED CYLINDER COMPLETE

THE AIR-COOLED CYLINDER

The air-cooled gas-engine cylinder can

be variously constructed to gain surface area, and there is now no determined standard practice. Some gray-iron cylinders have integral cooling surfaces, while others have applied radiating surfaces of different metals. Strangest of all, there is yet an enormous difference in the cooling area of successful cylinders of about the same bore and stroke, some having two or three hundred times the cooling surface added to the cylinder surface, that other successful air-cooled cylinder constructors find sufficient to keep their motor cool enough to work well.

When a gas engine is too hot it either grows weak and stops, or it burns the lubricating oil out of the cylinder, and so leads to cutting and sticking, or seizing between the piston and cylinder, and the high heat limit of successful small gas-engine working today, is the heat limit set by the new cylinder oils, which resist very high temperatures, so that small gas engines run well when hot enough to show straw color, pigeon's breast, or even dark blue on polished parts of the cylinder head.

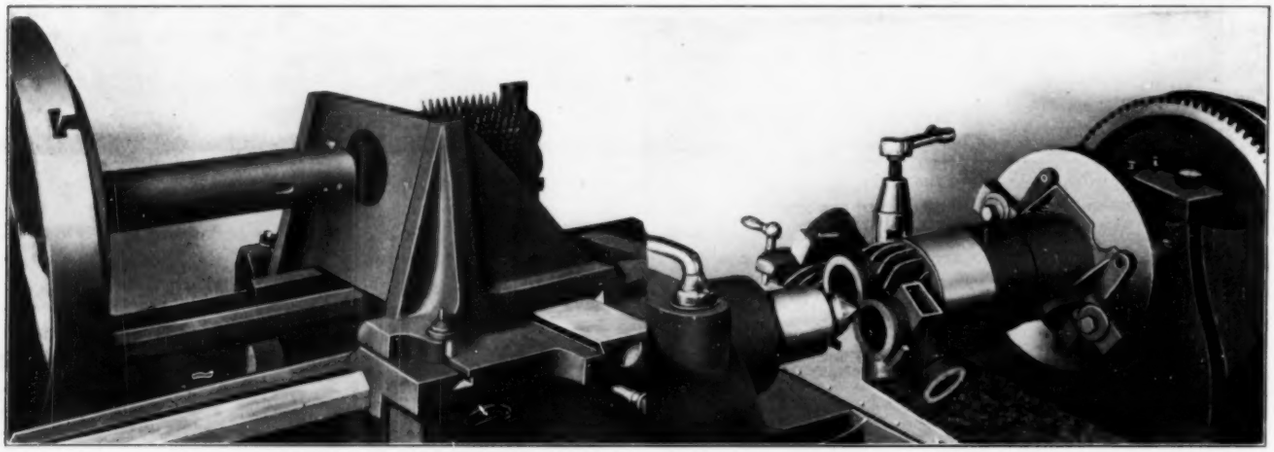


FIG. 2. FINISH BORING AFTER THE COOLING SPINES ARE IN POSITION

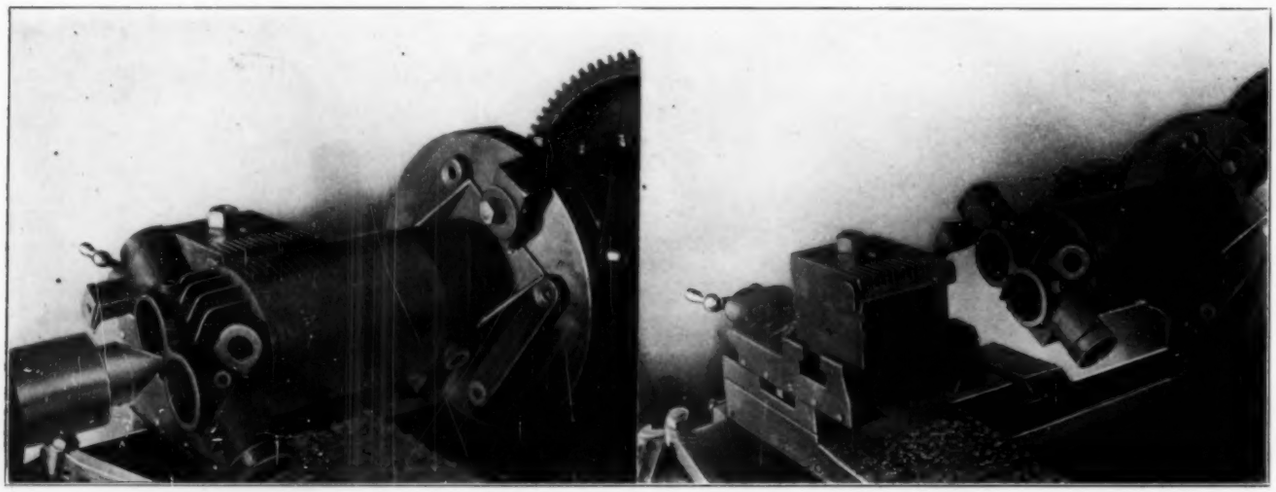


FIG. 3. MAKING THE CYLINDER BODY READY FOR CUTTING THE COMB-SEAT GROOVES

FIG. 4. CUTTING THE GROOVES WITH THE GANG TOOL SHOWN IN FIG. 5

FIG. 5. COMB-SEAT GROOVES CUTTING TOOL IN THE LATHE

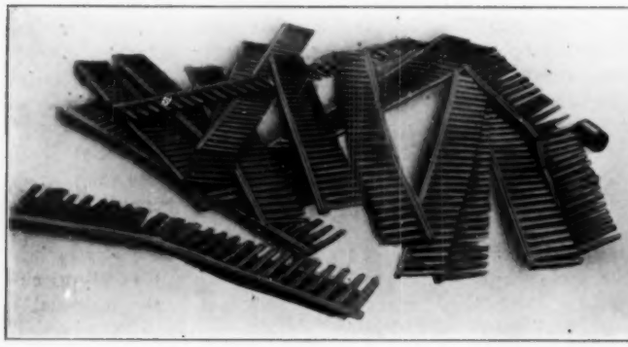


FIG. 6. SHEET STEEL COMBS AS FINISHED BY THE PUNCHING PRESS

FIG. 7. SEATING THE SPINES IN THE CYLINDER GROOVES

INTEGRAL AND APPLIED COOLING SURFACES

The integral cylinder cooling surface extensions take the forms of spines and circumferential and lengthwise ribs. These ribs, again, are sometimes very short, thick, and few in number, and more often are very deep and thin and close together, so as to make very difficult molding.

The applied cooling surfaces take the

forms of steel pins, screwed into the cylinders, or of copper flanges, either driven on the finished cylinders, or set in the mold and fixed to the cylinders by having th fluid iron poured around the holding part of the copper flanges, or by fastening steel combs to the cylinders.

It should be borne in mind that heat is very slow to pass a metal joint, no matter how closely fitted, hence integral cooling extensions are the more effective.

EXAMPLE OF APPLIED COOLING SURFACES

The illustrations are from the practice of the Corbin automobile shops, New Britain, Conn. The first Corbin cylinders had lengthwise steel cooling combs, staked or calked into grooves milled lengthwise in the gray-iron cylinders of polygonal section. The lengthwise comb was soon abandoned in favor of circumferential comb placing, the straight steel combs being bent in course of the fixing operation to full circles.

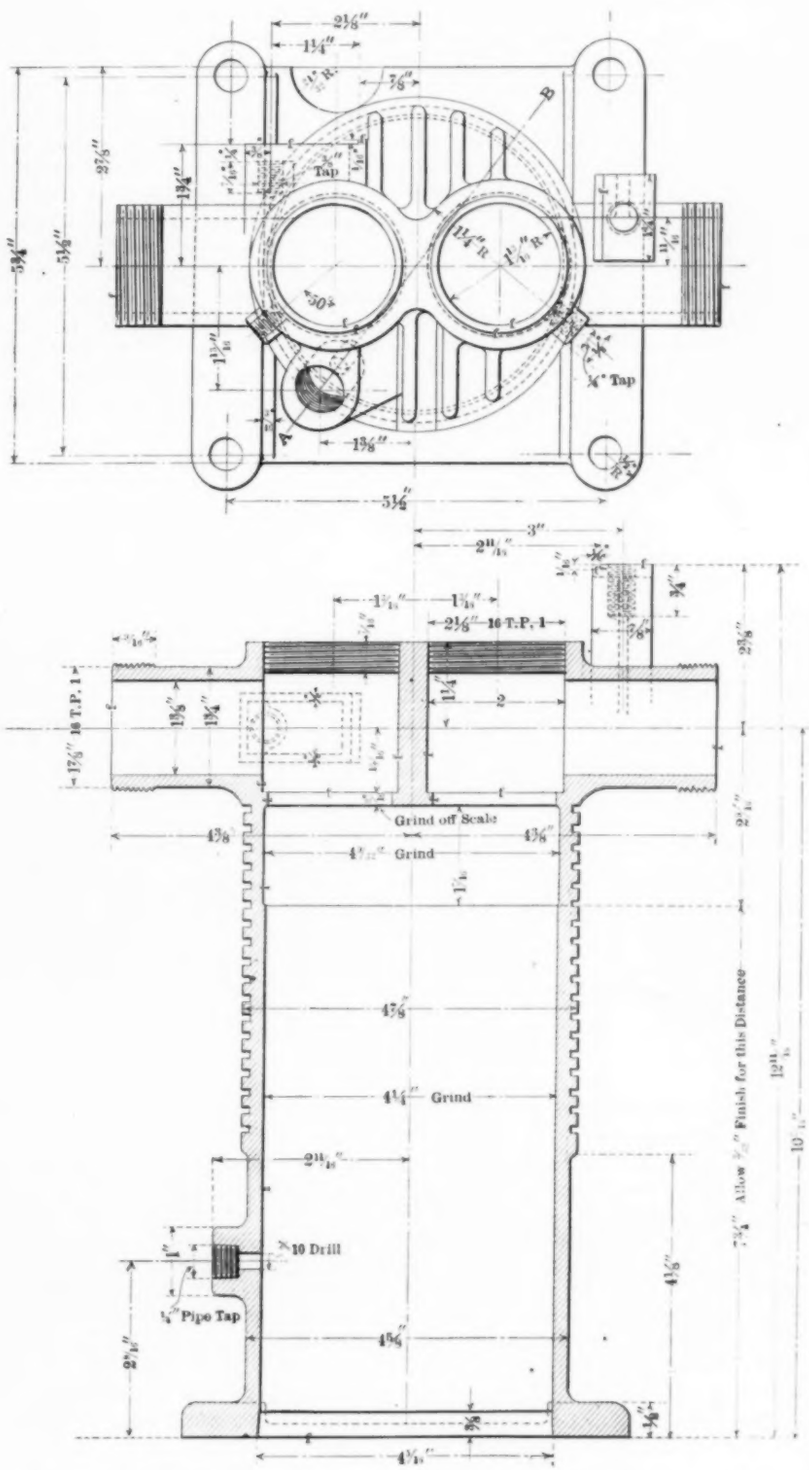


FIG. 8. CORBIN AIR-COOLED GAS ENGINE CYLINDER. WORKING DRAWING REPRODUCTION WITH ALL INSCRIPTIONS AND DIMENSIONS

Operation times were refused at the Corbin shops, so that the reader must form his own estimate of the labor cost of the Corbin air-cooled cylinder. The Corbin air cooling is regarded as wholly satisfactory, and the construction methods here shown bid fair for continuance.

At the time of this writing the Corbin cylinders were founded by the Brown & Sharpe Manufacturing Company. The weight of one cylinder rough, dimensions shown in working-drawing reproduction, is 21 pounds 4 ounces, and the finished-cylinder weight, with the spines applied, is, oddly enough, just the same, 21 pounds 4 ounces.

The full width of the applied steel "combs" is 1½ inches. The comb grooves in the cylinders are ⅛ inch deep, leaving the radiating spines or comb teeth to project 1⅜ inches as against a very much smaller number of integral projections only ¼ inch long in the Frayer-Miller air-cooled cylinders, which have the smallest cooling-surface area known to me, in successful practice.

The time required to place the cooling ribs of one Corbin cylinder is about 1½ hours. A request for the cylinder-finishing operations in sequence, with operation times, was refused. The cost of the Corbin cylinder is not small, nor is its weight low, when compared with other air-cooled cylinders, as will be shown in these air-cooled cylinder stories. At the same time, it is only fair to say that the Corbin cylinder weight, labor-hours cost and total cost are well below the figures for some of the very best integral cooling-rib cylinders.

As said at the outset, practice in cylinder air-cooling is yet chaotic, and the comparisons forced by the juxtaposition of the air-cooled cylinder construction stories in this series cannot fail to be of much advantage to car-motor constructors at large.

Fig. 1 shows the completed Corbin air-cooled cylinder in three positions, and Fig. 8 is the construction-drawing reproduction, with all dimensions. The spines are mutilated to permit the placing of a vertical member close to the cylinder body at one place.

The open end of the cylinder has a tapered mouth, to facilitate the entering of the piston and rings.

THE OPERATIONS OF MAKING THE CYLINDERS

The finishing routine comprises something like twenty operations, not all of which are specified. The cylinders are first finished on the flange face, and are then drilled for the retaining bolts or studs, two opposite holes taking the spotting pins on the face plate and angle

plate in re-chucking. The cylinders are rough-bored, as in Fig. 2, which, however, shows the finish-boring operation, and are then chucked, as in Fig. 3, centered to take the tail center, and turned over the spine-groove surface. Next the cylinders are grooved, as shown in Fig. 4, with the gang of grooving tools shown in Fig. 5, making them ready to take the combs, which are shown in Fig. 6. The tool stock of Fig. 5 is accurately grooved, and the inserted cutters are held with one through pinching bolt. All cutters are ground on the top face in a grinding machine, in position in the cutter stock, which is, in this illustration, moved to the left of the working position to show the bank of grooving cutters.

The combs shown in Fig. 6 are of sheet steel ⅛ inch thick. Those shown at the extreme right and left are bent in the middle, ready to apply when beginning the seating operation, as shown in Fig. 7.

These combs are not cut in the Corbin shops, and the press tools for producing them, which must be of interest, were not known there. Fig. 7 shows a turned wooden vise-horse, on which the cylinder is slipped and rotated as the comb placing proceeds. The combs are exactly the right length to fill the groove, and are pened with a round-end tool in the round bottom between two teeth to make them hug the groove bottom. Finally, the combs are made a close fit by the use of a pneumatic calking tool, which is applied to groove the cylinder next to the comb side. The cylinder bore then has a finishing cut taken through it, as shown in Fig. 1.

The Corbin motor-car factory is at New Britain, and the shop practice is in the best Connecticut manner. The tools and fixtures used are worthy of study, and the gang-tool construction is very good, indeed.

The thanks of the readers are due to the Corbin management, which gave all information requested, save as to routine and operation times, which were in the course of improvement.

It is very difficult to cast aluminum successfully in iron molds, owing partly no doubt to the high shrinkage of the metal and also to certain inherent qualities which distinguish it altogether from those metals which do give good results in metal molds. It is doubtful if aluminum can be cast even in the simplest forms in a metal mold so as to secure a thoroughly smooth surface, one which would not require polishing. The only precaution is to be careful not to have the molds nor the metal too hot. Best results occur when the heat of the mold is only moderate. If the mold gets too hot there seems to be a tendency for the metal to oxidize and form what might be called "feathers" on the exterior, which very much highten the roughness of the casting—*The Metal Industry.*

THE SHAPE AND DUTY OF ROUGHING TOOLS—I*

BY FRED. W. TAYLOR

In our practical experience in managing shops we have found it no easy matter to maintain at all times an ample supply of cutting tools ready for immediate use by each machinist, treated and ground so as to be uniform in quality and shape; and the greater the variety in the shape and size of the tools, the greater becomes the difficulty of keeping always ready a sufficient supply of uniform tools. Our whole experience, therefore, points to the necessity of adopting as small a number of standard shapes and sizes of tools as practicable. It is far better for a machine shop to err upon the side of having too little variety in the shape of its tools rather than on that of having too many shapes. And the energy of the department for maintenance of tools should be directed rather toward securing an ample and uniform supply of tools limited to a few shapes than to a great variety. The writer can hardly lay too much stress upon this point and it, therefore, becomes all the more important to use the greatest care and judgment in selecting the standard shape which is to be used for roughing tools.

STANDARD TOOLS ILLUSTRATED

In Fig. 4† is illustrated the shape of the standard tools which we have adopted, and in justification of our selection the writer would state that these tools have been in practical use in several shops both large and small through a term of years, and are giving general, all-round satisfaction.

CONFLICT BETWEEN THE DIFFERENT OBJECTS TO BE ATTAINED IN CUTTING METALS WHICH AFFECT THE DESIGN OF STANDARD TOOLS

Our standard tools may be said to represent a compromise in which each one of the elements has received most careful consideration, and has had its due influence in the design of the tool; and it can also be said that hardly a single element in the tools is such as would be adopted if no other element required consideration.

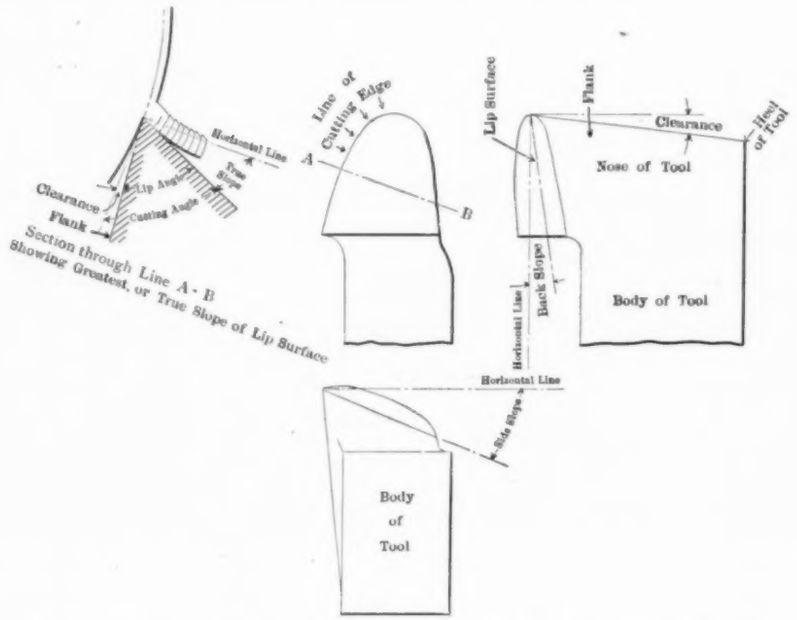


FIG. 1. DEFINITIONS OF TERMS USED. TOOL ABOUT TWO-THIRDS USED AWAY

The following, broadly speaking, are the four objects to be had in mind in the design of a standard tool: (*a*) The necessity of leaving the forging or casting to be cut with a true and sufficiently smooth surface; (*b*) removing the metal in the shortest time; (*c*) the adoption of that shape of tool which shall do the largest amount of work with the minimum combined cost of grinding, forging and tool steel; (*d*) ready adaptability to a large variety of work.

As we go further into this subject the nature of the conflict between these four objects and of the sacrifice which each element is called upon to make by one of the others will become apparent. To illustrate the nature of these compromises:

Generally speaking, we have been obliged

*Extract from the Presidential address before the American Society of Mechanical Engineers. Fig. 1 gives the author's definitions of the various parts of a tool.

†The paper gives drawings of tools from ½ to 1¼ inch steel corresponding to Fig. 4 which has been selected as a sample.—Ed.

to adopt as our standard shape a tool which can be run at only about, say, five-eighths of the cutting speed which our knowledge of the art and our experiments show us could be obtained through another tool of entirely different shape if no other element than that of cutting speed required consideration.

We have been obliged to sacrifice cutting speed to securing smaller liability to chatter; a rather truer finish; a greater all-round convenience for the operator in using the tool; and a comparatively cheaper dressing and grinding. The most important of the above considerations, however, is the freedom from chatter.

On the other hand, we have been obliged to adopt a rather more elaborate and expensive method of dressing the tools than is usual in order to provide a shape of tool which allows it to be ground a great many times without redressing, and also in order to make a single Taylor-White heat treatment of the tool last longer than it otherwise would. And again, the shape of the curve of the cutting edge of the tool which we have adopted—first, to insure against chatter, and second, for all-round adaptability in the lathe—calls for much more expense and care in the grinding that would be necessary if a more simple shape were used. This necessitates in a shop either a specially trained man to grind the tools by hand to the required templets and angles or preferably the use of an automatic tool grinder.

The chemical composition of the steel from which the tool is made and the heat treatment of the tool will, of course, receive the most careful consideration in the adoption of a standard tool. No shop, however, can now afford to use other than the "high-speed tools," and there are so many makes of good tool steels, which, after being forged into tools and heated to the melting point according to the Taylor-White process, will run at about the same high cutting speeds, that it is of comparatively small moment which particular make of high-speed steels is adopted.

EFFECT OF THICKNESS OF SHAVING ON CUTTING SPEED THE MOST IMPORTANT SUBJECT FOR EXPERIMENT

It is the *thickness of shaving* which must be first considered, as this element has more effect upon the design of our standard tools, and in fact upon the whole problem of cutting metals than any other single item which is completely under the control of those who are managing a shop.

To make it more apparent that the element affecting the cutting speed the most is the thickness of the shaving, the writer would call attention to the fact that dividing the thickness of the shaving by 3 increases the cutting speed in the ratio of 1 to 1.8, while dividing the depth of the cut by 3 only increases the cutting speed in the ratio of 1 to 1.27.

From these ratios it will be seen that the thickness of the chip has about three times as great an effect in modifying the cutting speed as has the depth of the cut.

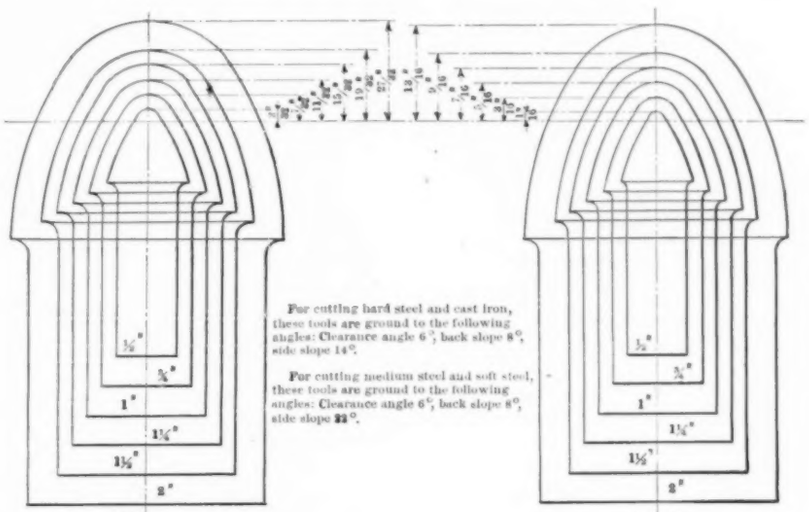

For cutting hard steel and cast iron, these tools are ground to the following angles: Clearance angle 6°, back slope 8°, side slope 14°.
For cutting medium steel and soft steel, these tools are ground to the following angles: Clearance angle 6°, back slope 8°, side slope 22°.
½"
¾"
1"
1¼"
1½"
2"

FIG. 2

BLUNT TOOL FOR CUTTING HARD STEEL AND CAST IRON

FIG. 3

SHARP TOOL FOR CUTTING MEDIUM AND SOFT STEEL

PRINCIPAL OBJECT IN HAVING THE CUTTING EDGE OF TOOLS CURVED IS TO INSURE AGAINST DAMAGE TO THE FINISHED SURFACE OF THE WORK

The experiments upon the effect of thickness of shaving on cutting speed enable us to explain from the theoretical standpoint the well known fact that each properly designed roughing tool should have the line or contour of its cutting edge curved as it approaches the extreme nose of the tool or that portion of the tool which insures a good and true finish of the work. A tool whose cutting edge forms a curved line of necessity removes a shaving which varies in its thickness at all parts. The only type of tool which can remove a shaving of uniform thickness is one with a straight-line cutting edge. The object in having the line of the cutting edge of a roughing tool curved as that part of the cutting edge which does the finishing is approached, is to thin down the shaving at this point to such an extent as will insure the finishing part of the tool remaining sharp and uninjured even although the main portion of the cutting edge may have been ruined through overheating or from some other cause.

The effect of a curved cutting edge upon the thickness of the shaving will be seen by inspecting Fig. 7.

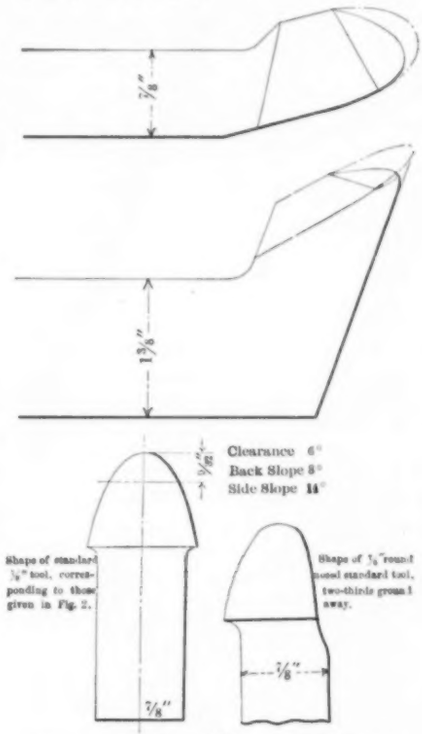


FIG. 4. STANDARD ⅞-INCH TOOL WITH WHICH MOST OF THE EXPERIMENTS HAVE BEEN MADE

The broken lines show shape of tool as forged.

The solid lines show shape of tool as ground, for cutting hard steel and cast iron. These tools are ground to the following angles: Clearance angle 6°, back slope 8°, side slope 14°.

For cutting medium steel and soft steel these tools are ground to the following angles: Clearance angle 6°, back slope 8°, side slope 22°.

For the exact curves of the cutting edges see Figs. 2 and 3.

It will be observed that the quality and accuracy of the finish left upon the work will depend upon maintaining sharp and uninjured throughout the cut that portion of the cutting edge of the tool which extends, say, from about point 0.005 inch to point 0.02 inch.

By examining the standard cutting speeds it will be seen that the standard* or ruining speed at point 0.04 inch, for instance, on the curve of our enlarged tool, is 13 feet. From this it is evident, then.

*Elsewhere in the paper the author says: "Throughout this paper, the speed at which tools give out in 20 minutes, will be, for the sake of brevity, referred to as the 'standard speed.'"

that if the tool enlarged in Fig. 7 were run at a cutting speed of 13 feet per minute so as to just ruin it at point 0.04 inch, the tool at point 0.01 inch would then be running at less than one-half of the cutting speed which would be required to ruin it. It would be, therefore, well within its safe limit of cutting speed, and would remain sharp and uninjured until the edge at 0.04 inch had entirely broken down. It is obvious then that a curved line cutting edge insures the finishing part of the tool from damage, and for this reason the cutting edges of all tools should be curved, at least, as that portion of the edge of the tool is approached which leaves the work of the proper size and with the proper finish.

TOOLS WITH BROAD NOSES HAVING FOR THEIR CUTTING EDGES CURVES OF LARGE RADIUS BEST TO USE EXCEPT FOR RISK OF CHATTER

Upon appreciating the increase in the cutting speed obtained through thinning down the shaving, as shown in our experiments with straight cutting edge tools, the tools shown in Fig. 8 were made and used on roughing work for years in the axle lathes of the Midvale Steel Company. The gain in cutting speed of these standard broad-nosed tools over our standard round-nosed tool, as shown in Fig. 4, is in the ratio of 1.30:1.

This general shape of tool continues to be extensively used, but it is subject to the disadvantage that it is likely to cause the work to chatter, and so leave a more or less irregular finish.

Were it not for this difficulty, added to the fact that our standard round-nosed tool has a greater all-round adaptability and convenience, the tools illustrated in Fig. 8 would undoubtedly be the proper shapes for shop standard.

REASONS FOR ADOPTING THE PARTICULAR CURVES CHOSEN FOR THE CUTTING EDGES OF OUR STANDARD TOOLS

Having explained the necessity for curved cutting edges in standard roughing tools, it is desirable to give our reasons for the adoption of the particular curves of our standard tools. It will be noted that as the body of the tool becomes smaller, the radii of curvature of the cutting edge also become correspondingly smaller. This change in the curve of the cutting edge is rendered necessary by the fact that the smaller tools are used in the small lathes, which, generally speaking, work upon small forgings, from which cuts are removed which are both shallow in depth and have comparatively fine feeds. Forgings which are small in diameter are quite as liable to chatter as the larger forgings which are machined in larger lathes, and in order to avoid this chatter, it is necessary that a curve for the cutting edge should be chosen which will give a variation relatively in the thickness of shaving even in small depths of cut. Thus, for the avoidance of chatter, the curve of the cutting edge should be small in proportion as the depth of cut and feed which it normally takes are small.

As will be seen later, the smaller radius of curvature of the cutting edge involves a diminution in cutting speed. Therefore, with larger-sized tools it becomes important, on the other hand, to take as large a radius of curvature for the cutting edge as is compatible with freedom from chatter. The coarser feed which usually accompanies the larger tool also calls for a larger radius of curvature at the nose of the tool, in order that the ridges left by the spiral path of the tool along the forging shall be as low as practicable.

The all-round adaptability of the standard tool to a variety of uses also calls for a smaller radius of curvature the smaller the tool, since standard roughing tools are continually required to run up against a shoulder or into a corner on the work, and the fillet in this corner is normally small in proportion as the forging or casting is small.

By comparing curves of the tools shown in Figs. 2 and 3, it will be observed that tools which are to be used for cutting cast iron and hard steel, have slightly larger radii of curvature than those which are to be used for the softer steel and wrought iron. The reason for this change is that much slower cutting speeds must be used in cutting hard steels than for soft, and this is also to a less degree true for cast iron as compared with soft steel.

It is a matter of common experience that the slower the cutting speed, the less the liability of the tool to chatter. It therefore becomes safe from the standpoint of chatter to use in cutting hard steel and also cast iron a larger radius of curvature than would be permissible in cutting soft steel. The fact has already been pointed out that the larger the radius of curvature, the thinner the shaving, and therefore the higher the cutting speed, and in the interest of economy, it is, of course, particularly desirable in cutting hard steels to increase the necessarily slow cutting speed as much as practicable.

For the following entirely different reason, also, the radius of curvature for tools to be used in cutting cast iron is made larger than in tools to be used in cutting soft steel. Cast iron is cut with less cutting pressure or resistance to the tool than is required for soft steel. Therefore, in a given lathe a greater depth of cut and coarser feed can be taken on cast iron than on soft steel; and, as explained above, the coarser the feed the greater should be the radius of curvature of the extreme nose of the tool in order to leave an equally smooth finish.

In many machine shops a very considerable portion of the work consists of cuts to be taken upon pieces of cast iron; the depth of the cut being comparatively shallow, and the strength and rigidity of the casting being so great that in order to use even approximately the full pulling power of the lathe or planer, etc., broad feeds must be taken. In our standard shop tools the extreme end of the noses are rounded with too small radii to take a very broad feed, and yet at the same time leave a reasonably smooth finish. It is therefore desirable in all such shops to have standard tools available which are especially designed for work of this character.

In Fig. 9 is illustrated a single size of the type of tool which we recommend for this purpose. It will be observed that in form it corresponds exactly to our other standard tools for cutting cast iron and hard steel, except that the extreme nose of the tool is widened out so as to have a

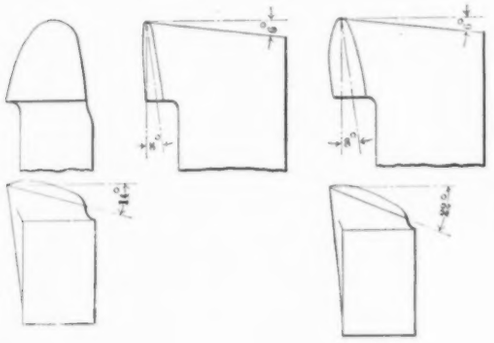


FIG. 5

FIG. 6

Fig. 5. Clearance angle, back slope and side slope in standard tools for cutting cast iron and hard steel. Tool about two-thirds used up.

Fig. 6. Clearance angle, back slope and side slope in standard tools for cutting medium and soft steel. Tool about two-thirds used up.

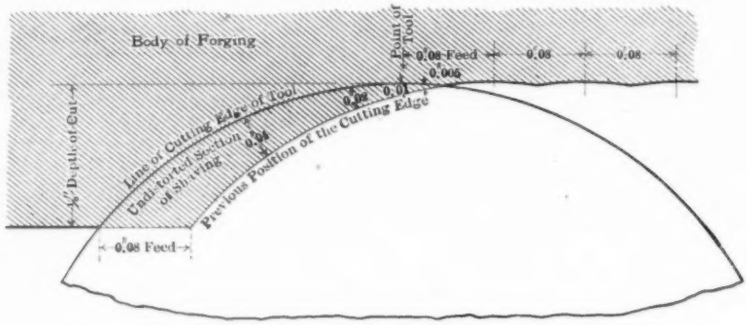


FIG. 7. ACTION OF CURVED CUTTING EDGE

curve of very large radius, approximating to a straight line.

LIP AND CLEARANCE ANGLES OF TOOLS

Contrary to the opinion of almost all novices in the art of cutting metals, the clearance angle and the back-slope and side-slope angles of a tool are by no means among the most important elements in the design of cutting tools, their effect for good or evil upon the cutting speed and even upon the pressure required to remove the chip being much less than is ordinarily attributed to them.

The following are our conclusions regarding the clearance angle of the tool. *a* For standard shop tools to be ground by a trained grinder or on an automatic grinding machine, a clearance angle of 6 degrees should be used for all classes of roughing work. *b* In shops in which each machinist grinds his own tools a clearance angle of from 9 degrees to 12 degrees should be used.

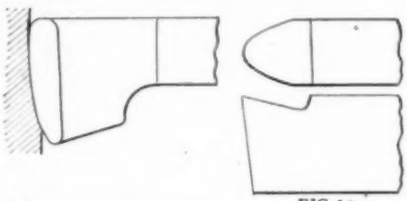


FIG. 10

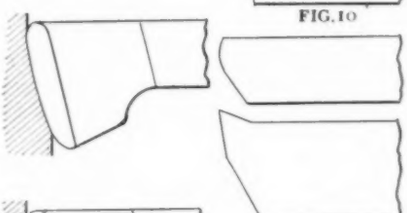


FIG. 11

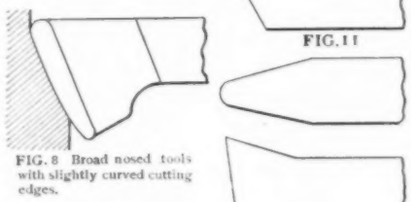


FIG. 8 Broad nosed tools with slightly curved cutting edges.

FIG. 9

FIG. 12

OUTLINE OF CUTTING EDGE OF TOOL FOR SHALLOW DEPTHS OF CUT AND WIDE FEEDS IN CAST IRON

BADLY SHAPED TOOLS

The clearance angles for roughing tools in common use vary between 4 degrees and 12 degrees. We have had experience on a large scale in different shops with tools carefully ground with clearance angles of 5 degrees, 6 degrees and 8 degrees. In the case of one large machine shop which had used clearance angles ground to 8 degrees through a term of years, they finally adopted the 6 degrees clearance angle with satisfaction. For many years past our experiments have all been made with the 6-degree clearance angle, and this has been demonstrated to be amply large for our various experiments. On the other hand, a 5-degree clearance angle in practical use in a large shop has appeared to us through long-continued observation to grind away the flank of the tool just below the cutting edge rather more rapidly than the 6 degrees angle. We have, therefore, adopted the 5 degrees clearance angle as our standard.

A CLEARANCE ANGLE OF FROM 9 TO 12 DEGREES SHOULD BE USED IN SHOPS IN WHICH EACH MACHINIST GRINDS HIS OWN TOOLS

It should be noted, however, that in shops systematized by us the cutting tools are invariably ground either on an automatic tool grinder, or by special men who are carefully taught the art of grinding and provided with suitable templets and gages, and that in this case the clearance angle for every tool is accurately made to 6 degrees.

In shops, however, in which each lathe or planer hand grinds his own tools, a larger clearance angle than 6 degrees should be used, say, an angle of from 9 degrees to 12 degrees, because in such shops in nine cases out of ten the workmen grind the clearance and lip angles of their tools without any gages, merely by looking at the tool and guessing at the proper angles; and much less harm will be done by grinding clearance angles considerably larger than 6 degrees than by getting them considerably smaller. It is for this reason that in most of the old style shops in which the details of shop practice are left to the judgment of the men or to the foreman, that clearance angles considerably larger than 6 degrees are generally adopted.

LIP ANGLE OF THE TOOL

The following are the conclusions arrived at regarding the angles at which tools should be ground:

(*A*) For standard tools to be used in a machine shop for cutting metals of average quality: Tools for cutting cast iron and the harder steels, beginning with a low limit of hardness, of about carbon 0.45 per cent., say, with 100,000 pounds tensile strength and 18 per cent. stretch, should be ground with a clearance angle of 6 degrees, back slope 8 degrees, and side slope 14 degrees, giving a lip angle of 68 degrees.

(*B*) For cutting steels softer than, say, carbon 0.45 per cent. having about 100,000 pounds tensile strength and 18 per cent. stretch, tools should be ground with a clearance angle of 6 degrees, back slope of 8 degrees, side slope of 22 degrees, giving a lip angle of 61 degrees.

(*C*) For shops in which chilled iron is cut a lip angle of iron 86 degrees to 90 degrees should be used.

(*D*) In shops where work is mainly upon steel as hard or harder than tire steel, tools should be ground with a clearance angle of 6 degrees, back slope 5 degrees, side slope 9 degrees, giving a lip angle of 74 degrees.

(*E*) In shops working mainly upon extremely soft steels, say, carbon 0.10 per cent. to 0.15 per cent., it is probably economical to use tools with lip angles keener than 61 degrees.

(*F*) The most important consideration in choosing the lip angle is to make it sufficiently blunt to avoid the danger of crumbling or spalling at the cutting edge.

(*G*) Tools ground with a lip angle of about 54 degrees cut softer qualities of steel, and also cast iron, with the least pressure of the chip upon the tool. The pressure upon the tool, however, is not the most important consideration in selecting the lip angle.

(*H*) In choosing between side slope and back slope in order to grind a sufficiently acute lip angle, the following considerations, given in the order of their importance, call for a steep side slope and are opposed to a steep back slope: *a* With side slope the tool can be ground many more times without weakening it; *b* The chip runs off sideways and does not strike the tool posts or clamps; *c* The pressure of the chip tends to deflect the tool to one side, and a steep side slope tends to correct this by bringing the resultant line of pressure within the base of the tool; *d* Easier to feed.

(I) The following consideration calls for at least a certain amount of back slope. An absence of back slope tends to push the tool and the work apart, and therefore to cause a slightly irregular finish and a slight variation in the size of the work.

(J) For conclusions as to clearance angle, see above.

MOST IMPORTANT CONSIDERATION IN CHOOSING LIP ANGLE IS TO MAKE IT SUFFICIENTLY BLUNT TO AVOID DANGER OF CRUMBLING OR SPALLING OFF AT THE CUTTING EDGE

In deciding upon the acuteness of the lip angle of a tool the absolute necessity of guarding against the spalling or crumbling of the cutting edge becomes by far the most important of all considerations. In this connection the essential fact to be borne in mind is that the harder the metal to be cut, the blunter must be the lip angle of the tool. In the case of chilled iron and semi-hardened steel, for instance, the lip angle must be made from 86 degrees to 90 degrees. A smaller angle than this will cause the metal at the extreme cutting edge to spall off or crumble away (quite as much on account of the feeding pressure as from the pressure of the chip) and thus ruin the tool. As the metal to be cut grows softer, however, the lip angle can be made keener without danger of spalling, until with standard tools intended to cut the softer steels, say with a high limit for hardness of about 100,000 pounds tensile strength and 14 per cent. to 18 per cent. stretch, the smallest lip

angle which, in our judgment, it is on the whole wise to use would seem to be about 61 degrees.

Dr. Nicolson with his dynamometer experiments has shown that with a "cutting angle" of 60 degrees, corresponding to a lip angle of 54 degrees, clearance angle 6 degrees, tools remove metal with the minimum of pressure. This is also corroborated in a general way by our observations in cutting dead soft steel. Therefore from the standpoint of pressure, with a view to taking the largest cut with a given pulling power and with the least strain upon the working parts of the lathe, this angle should be approached. And although, on the whole, the question of pressure on the tool has less weight than either the crumbling at the cutting edge, the cutting speed, or the proper angles for obtaining the longest life and the largest number of grindings for a given tool, still it must be considered; and it is this which has led us to choose for our standard in each case *the keenest cutting angle which is free from danger of spalling.*

Metals which even approach in hardness chilled iron and semi-hardened steel are but seldom met with in ordinary shop practice and, therefore, in selecting the lip angles for standard shop tools, we have divided the metals to be cut in a shop into two classes: *a* cast iron and the harder classes of steel, say, beginning as a low limit for hardness with a steel of about 0.45 to 0.50 per cent. carbon, 100,000 pounds tensile strength and 18 per cent. stretch; and *b* the softer classes of steel.

Our guiding principle in selecting the lip angles for the tools to be used in cutting cast iron and the harder classes of steel has been to select what we believe to be the smallest or most acute lip angle which can be safely depended upon to run without danger of spalling off at the cutting edge while cutting the harder steels ordinarily met with in machine-shop practice (such as the hardest steels used in this country for car-wheel tires, say of 135,000 to 140,000 pounds tensile strength, and 9 to 10 per cent. of stretch, and, for instance, unannealed tool steels, or the harder of the oil-hardened and annealed forgings which are used under Government specifications for making large steel cannon, etc.); and after large experience in cutting metals of this quality we have concluded that it would be unsafe to use a more acute lip angle than 68 degrees, with clearance angle of 6 degrees, side slope of 14 degrees and back slope of 8 degrees. We have demonstrated by repeated trials that tools with the above lip angle are safe from danger of spalling or of crumbling at the cutting edge, even when cutting tire steel, gun steel or tool steel.

For shops which are engaged mainly in cutting steels as hard as tire steel, we should recommend as a standard tool one having 6 degrees clearance, 5 degrees back slope and 9 degrees side slope, giving a lip angle of 74 degrees. Since for this special work the tools can be run at a high cutting speed, they can be ground in less time and they can be ground more times for each dressing in the smith shop than tools with more acute lip angles.

In those shops which work upon metals of average hardness and in which the tools are furnished to the machinists ground to the required shapes, and in which either automatic tool grinders are used or special grindstone men are employed to grind the tools, more work can be gotten out by grinding the tools to angles at least closely approximating ours than from the use of tools with blunter lip angles.

The reason for preferring the more acute lip angle of 68 degrees, for cutting medium hard metals, to the angle of 75 degrees to 85 degrees adopted by the average machinist, is that the more acute angle removes the metal with a lower pressure on the tool; while repeated experiments made by us in cutting medium hard steels indicate that there is little if any difference in cutting speed between the 68 degrees lip angle and coarser angles. Our standard tools, therefore, are capable of taking heavier cuts than the blunter tools, and in a given machine working to the limit of its pulling power can remove rather more metal in a given time.

WHY TOOL FOR CUTTING SOFT CAST IRON SHOULD HAVE BLUNTER LIP ANGLE THAN TOOL FOR CUTTING SOFT STEEL

It may be a matter of surprise to some that we have adopted a lip angle of 68 degrees for cutting the softer grades of cast iron, while we recommend a lip angle of 61 degrees for the softer steels. It is one of the strange anomalies met with in so many of the elements of this art, however, that if we experiment with a very soft cast iron, on the one hand, and a very soft steel on the other—the standard cutting speeds of which are each, say, 150 feet per minute with a 3/16-inch depth of cut and 1/16-inch feed—in the case of the soft steel the highest speed can be obtained only with a cutting edge at least as keen as 61 degrees, and we believe even keener, while the lip angle corresponding to the highest cutting speed with soft cast iron is 68 degrees or even blunter.

WHY TOOLS SHOULD BE GROUND WITH GREATER SIDE SLOPE THAN BACK SLOPE

We have endeavored above to make it clear that the paramount consideration affecting the choice of the lip angle for standard tools has been the avoidance of the danger of spalling or crumbling at the cutting edge. Having chosen a lip angle which is sufficiently blunt to avoid danger from this cause, it must still be decided whether this angle shall be produced, say, altogether by side slope or altogether by back slope, or by a combination of side slope and back slope; and in settling this question there are several important, and, as usual, conflicting considerations. These may be divided into the following groups, which are given in the order of their importance: *a* Ease and cheapness of grinding and the effect of repeated grindings upon the strength and life of the tool; *b* guiding the chip in the proper direction for convenience in operating; *c* the effect of pressures produced by side slope and back slope upon the tendency of the tool to gouge or plunge either forward or sideways; *d* the power required to feed.

BACK SLOPE NEEDED TO SECURE BETTER FINISH AND GREATER ACCURACY IN SIZE

A study of all of the above elements would lead to the conclusion that tools should be designed with all side slope and no back slope. There is, however, one element which makes it desirable to have a certain amount of back slope; namely, the fact that a steep back slope diminishes the tendency of the chip to push the tool and the work away from one another, and it is evident that the greater the pressure tending to force the tool and the work apart, the greater will be the irregularity in the finish left by the nose of the tool upon the work. This irregularity both in size and finish is particularly noticeable in those cases in which the tool and its supports are not especially rigid, and in which the depth of the cut varies from one part of the forging to another; and also when the surface of the forging is more or less eccentric or uneven owing to the irregularities left by the hammer in forging.

We have made repeated careful experiments with lathes having springy tool supports and with more or less lost motion, and in such machines, providing the tool is fastened tight in the tool post, we have found that the tools ground to our standard angles very rarely gouge or plunge forward or sideways seriously. The danger of plunging forward, however, has been one of the reasons influencing the adoption of a back slope as small as 8 degrees.

The tendency of the tool and work to push apart, on the other hand, is very marked with tools designed with all side slope and no back slope.

The Houston, Stanwood & Gamble Company, of Cincinnati, while it does not maintain so elaborate a trade school as has recently been referred to in our columns, yet endeavors to do something along this line for its apprentices, and during working hours, and while under the pay of the company, its apprentices are taught arithmetic, elementary algebra, reading, writing and geography. Recently, however, there has been some difficulty in securing a suitable teacher for this school, and they are looking for a young man who can teach the branches named above during part of the time of each day; the rest of the time to be spent in the shop in some capacity.

AN EXTRA-HEAVY SLAB MILLING MACHINE

EDITORIAL CORRESPONDENCE

The accompanying illustrations show a slab milling machine by the Newton Machine Tool Works, of Philadelphia, which is not only of great weight and power, but of novel design in several particulars.

As an indication of its massive proportions, it may be mentioned that its main spindle is 6½ inches diameter in its bearing, which is 15 inches long, while the machine is driven by a two to one variable speed motor of 35 horse-power. Except for the driving worm, which is of bronze and of the steep-lead type, and the bronze spiral table-feed pinion, the gears are all of steel, the main driving worm-wheel being case-hardened and the ratio of worm and worm-wheel being 20 to 1. The worm step is a roller-thrust bearing.

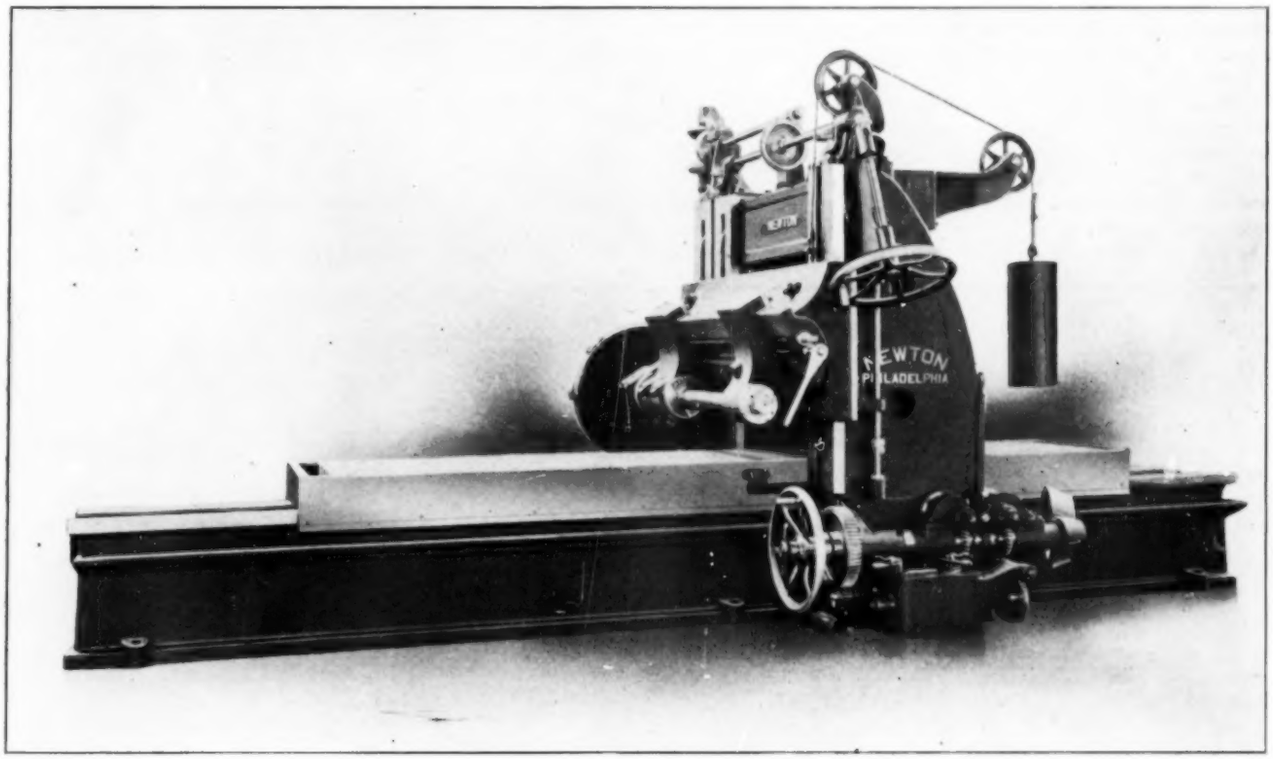


FIG. 1. A HEAVY SLAB MILLING MACHINE

DETAILS FOR SECURING RIGIDITY

Every effort has been made to secure a rigid arbor drive and support, the drive being by a "butterfly" or cross key, which is integral with the flange on the arbor and engages with a slot across the end of the spindle. The outboard bearing has a bush with a parallel hole, and an external taper to compensate for wear. This bush takes bearing directly on the arbor collars and may thus be adjusted close up to the cutter, reducing the unsupported length of the arbor to the shortest possible amount. The arbor projects through the bearing with the clamping nut external to it. The absence of a step at the outboard bearing makes it feasible to adjust the arbor lengthwise after all other adjustments have been made, and an adjustment of eight inches is provided by means of the upper cross-rail screw, the lower screw adjusting the outboard bearing.

SINKING THE CUTTER AT THE BEGINNING OF A CUT

Much of the work for which such a machine is used, for example fluting the side rods of locomotives, involves sinking the cutter into solid metal at the beginning of the cut. The old arrangement of cross-rail with a vertical face involves a considerable projection of the arbor forward of the rail, the result being that the spring of the rail, due to the first bite of the cutter, is inclined downward, permitting the cutter to gouge into the work, leading to chatter and possible breakage of cutters. In the present machine, this tendency is largely reduced by inclining the face of the rail, as shown in the half-tones and more clearly in the cross section, Fig. 3, the action of the inclined cross-rail being similar to that of a goose-necked tool.

THE ELEVATING SCREW STEPS

Rigidity of the cutter under these circumstances is also largely increased by the fact that the cross-rail elevating screws are stepped at their bottoms instead of at their tops, the screws thus pulling the cutter into the work instead of pushing it, as with the reverse arrangement. There is also a provision to avoid the running backward of the table, and the consequent climbing of the cutter on the rear side of the cut when sinking in.

MILLING PAST PROJECTIONS

Another advantage of the inclined cross-rail is that, without excessive overhang, the arbor center may be dropped well below the edge of the rail, and thus make it possible to mill past projections, such as solid forged oil cups on connecting rods, and to mill keyways in large shafts having a wide variation in diameters at different parts. In the present machine the center of the arbor is four inches below the edge of the rail.

TRAVERSE MOVEMENTS

Quick power movement of table and rail in both directions is provided, and provision is also made for using the downward power movement of the rail as a feed when sinking the cutter at the beginning of a cut. The hand levers which control the quick traverse are so arranged as to move in the same directions as the resulting movement—forward, backward, up or down for corresponding adjustments.

THE GEAR BOX

The feed of the table is by a steel rack and bronze spiral pinion, the feeds being obtained by an extremely simple and compact gear box which accomplishes the remarkable result of giving nine speeds with nine gears, and with no idle gears in mesh. Fig. 4 is an interior view of this box, the gears of which are of steel and run in oil,

and have the ends of their teeth beveled to permit engagement when in motion. To distinguish the driving shaft a pulley has been placed upon it, although, in the machine, the connection is all through gears. The intermediate shaft will be seen to carry three gears of varying diameters, while the two outer shafts carry sliding splined quills on which additional gears are mounted. By manipulating suitable levels the quills are adjusted endwise to bring the different combinations of gears in mesh, and since the lower gears give three speeds for each position of the upper quill, the result is nine speeds which range from 1 to 10 inches per minute.

SOME MILLING RECORDS

During six months' continuous use the following cuts have been maintained which, each in its class, is believed to exceed all previous records in slab milling: Width of cut 9½ inches, depth of cut 9/16 inch, feed per minute, 8 inches, or a total of nearly 43 cubic inches of metal per minute, or about 1¼ cubic inches per minute per rated horse-power of motor; in fluting or channelling two locomotive side rods simultaneously, width of cut for each rod 3 inches, depth of cut 1½ inches, feed 3¼ inches per minute, giving a chip section of 9 square inches, and a removal of 29¼ cubic inches of metal per minute. The cutters used had inserted teeth of air hardened steel, the teeth being inserted on a true spiral. The peripheral speed of the cutters was 86 feet per minute.

THE ADVANCE IN MILLING-MACHINE CONSTRUCTION ILLUSTRATED

As an illustration of the advance in milling-machine construction, we give in Fig. 5 a half-tone of the first commercially successful Newton slab milling, which was made in 1884, and was considered a record-breaker. It was intended

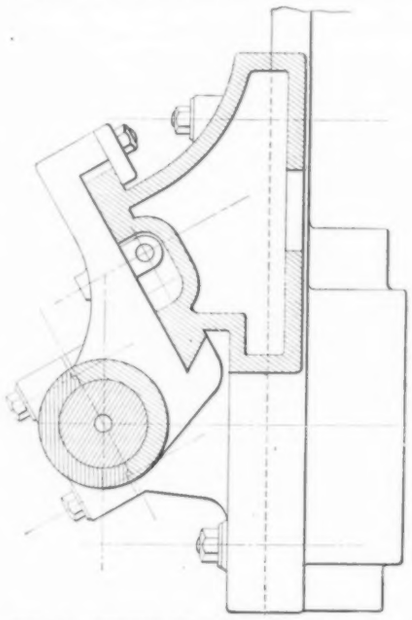


FIG. 3. SECTION OF INCLINED CROSS RAIL

for the same class of work as the machine under notice, including the fluting of locomotive side rods. The spindle drive was by a compound spur train, and the table feed by a spur pinion and rack, the quick traverse being by the hand crank. The reader will not fail to compare the inside square-lock table guide with the overlapping design of the present machine, and especially the cross-rail arbor support with the independently adjusted outboard bearing of the older machine.

F. A. H.

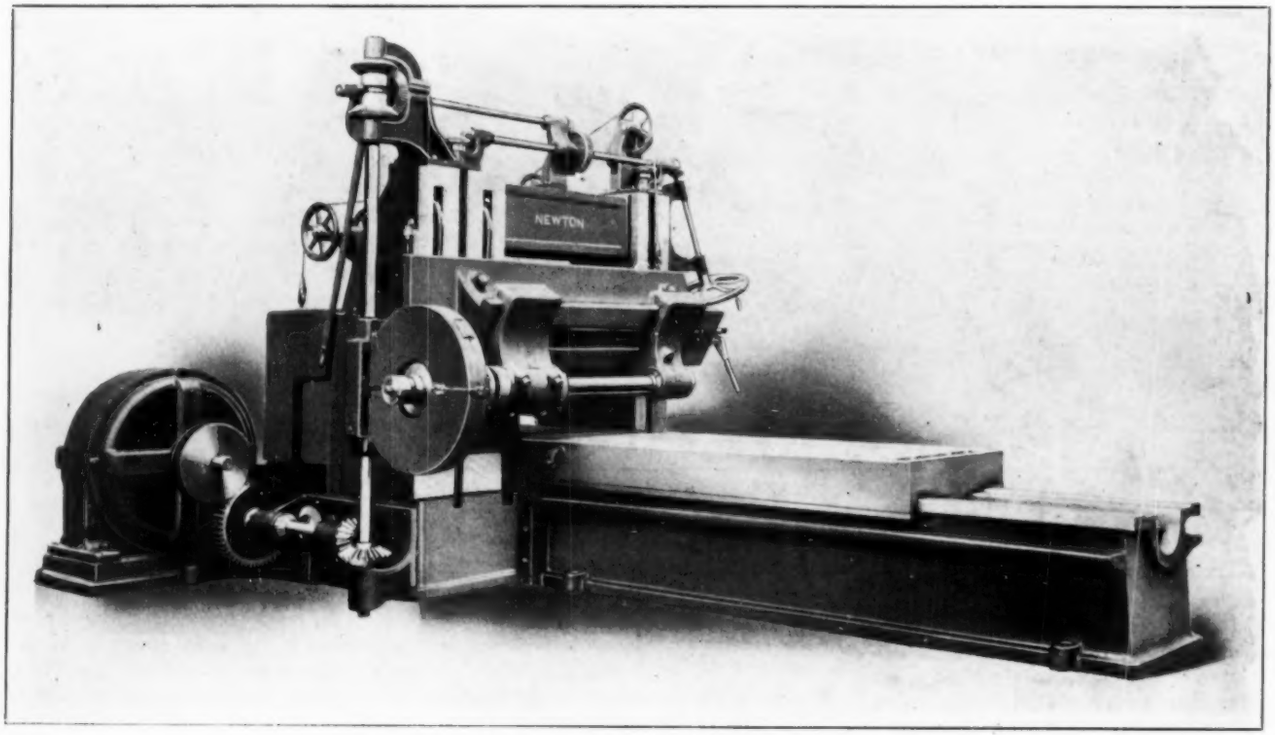


FIG. 2. A HEAVY SLAB MILLING MACHINE

Tempering Steel with Cyanide —Some Results Obtained by Its Use, and Some Instances Where It Should Not Be Employed

BY E. R. MARKHAM

Articles relating to the use of cyanide appear from time to time in the columns of the AMERICAN MACHINIST. Some writers seem to think its use should be encouraged, while others claim that it injures steel if brought in contact with it while the metal is red-hot. While reading these various opinions, it occurred to me that perhaps a few words might interest those who have never had an opportunity to experiment along this line, and to whom my experience might be of value at some time.

THE ACTION OF CYANIDE

When cyanide of potassium is applied to a clean surface which is heated nearly, or quite, to a red heat, it not only carbonizes the surface, but it also causes all scale, or other substance which may be on the surface, to scale off when the article is placed in the hardening bath, thus insuring the contents of the bath having access to every portion of the surface, and so doing away with a tendency toward soft spots which sometimes manifest themselves.

SOFT SPOTS

Soft spots in hardened pieces result from several causes; sometimes a scale of oxide will form on the surface and gas will form under this in spots called pockets, forming blisters. When the piece is immersed in the bath these blisters prevent the water—or other liquid—from coming in contact with the surface at these points, and the heat is not conveyed away sufficiently fast to cause the piece to harden.

SCALING THE SURFACE

Now anything that will cause the surface to scale immediately when the piece is immersed will do away with this difficulty, provided there is no other cause that must be counteracted.

Now, if it seems advisable to apply cyanide to the surface, and the operator is fearful of harmful results as a consequence of using it on high-carbon steel, it may be applied just before dipping in the bath, not giving it time to act on the steel under the surface.

TROUBLE FROM OVERHEATING

Many times harmful results are caused by high heat or from steel being exposed to the action of the heat for too long a period, rather than from anything that may have been placed on the surface. I remember a visit I made to a shop at one time where they were having trouble with cutters made from a high-carbon steel; the teeth, which were comparatively slender, would break in use. In order to get the teeth sufficiently hard a little cyanide was dusted on them about two minutes before they were dipped in the bath.

HARD BUT WEAK TEETH

The teeth were hard, but would not stand up when in use. An examination into their methods showed that pieces which should have been heated in five minutes were subjected to the heat for 40 minutes. The method of heating was changed, the cutters were brought to the hardening heat in five minutes, dipped in the bath without applying any cyanide and the teeth were sufficiently hard and stood up all right.

A CASE WHERE CYANIDE WAS NOT NEEDED

As the people here had an idea that the cyanide was injuring the steel, we applied it to a few of the cutters but could see very little, if any, difference in the strength of the teeth. And as there was no need of its being used it was discontinued; not that they found it harmful, but because it was unnecessary. The long heats had rendered the steel weak.

SCRAPER TROUBLES

I also remember visiting a shop where machine tools were manufactured, and found they could not harden their scrapers so they would stand up on the hard cast-iron surfaces they were scraping. They had experimented with various steels recommended by other concerns and by the steel makers, but with little success.

LOCATING THE DIFFICULTY

I had the blacksmith draw out a scraper and then harden it in order that I might follow the work and see if the fault was in the blacksmith shop. I was convinced that the man understood his business, and that the fault must be elsewhere; so I watched the scraper hands grind, hone, and use the scrapers, and they apparently understood their business. So I then took one of the tools and hardened it over, heating to a low red, then placed a little cyanide on the end, reheated to a low red and hardened.

A SATISFACTORY SCRAPER

When it was tested I was requested to reharden all the scrapers and although the superintendent was bitterly opposed to its use before that, I am able to say that all scrapers since used in that shop are treated to a dose of cyanide; and that was about five years ago.

If I were asked the question, "Do you always use cyanide on scrapers?" my answer would be, no, not unless it seems advisable.

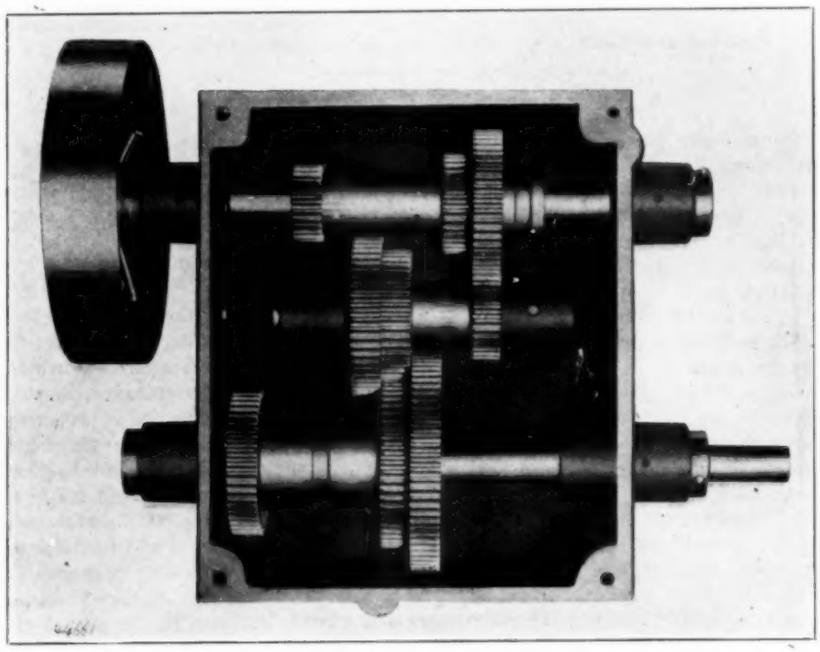


FIG. 4. INTERIOR OF GEAR BOX

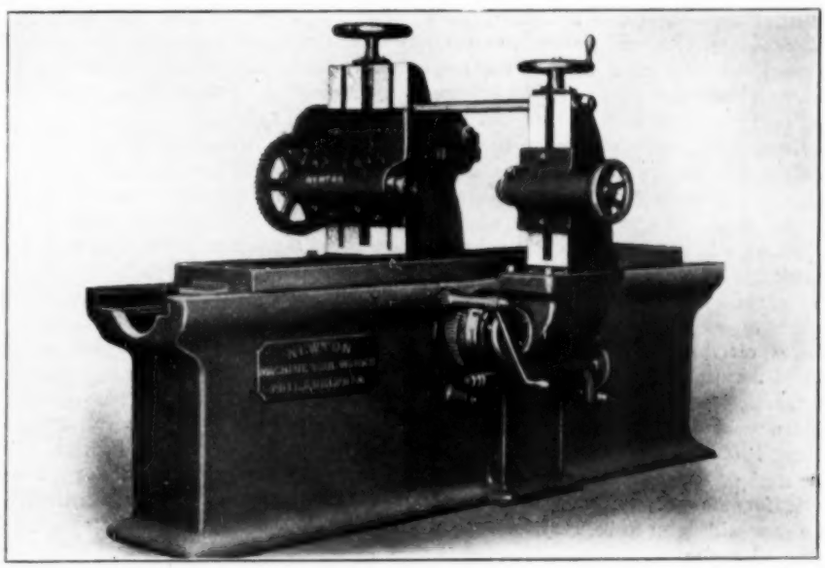


FIG. 5. A SLAB MILLING MACHINE OF 1884

CYANIDE BATH AND A CASE-HARDENING JOB

I think many readers of this paper know that many nice stamping dies are heated for hardening in a crucible of red-hot cyanide; and this certainly gives excellent results.

My attention was called at one time to a gun frame, which, when case-hardened, showed soft at the point where the main spring seated. As these frames were dipped one at a time it was little trouble to apply cyanide at this point, and a tough surface hardened sufficiently deep to resist wear was produced.

A SIMILAR JOB PACK HARDENED

In another shop where the same trouble was experienced, but where it was found necessary to produce a deeply hardened surface, the cyanide was applied when the frames were packed in the case-hardening box. This seemed necessary as the bone used as carbonizing material did not seem to produce the desired result at this point. The cyanide seemed to cause the surface to scale when it touched the oil in the bath. Of course, the frames under consideration were from a low-carbon open-hearth steel.

HARDENING DISKS

I recall just now some disks made from 1.4 per cent. carbon crucible tool steel which showed soft spots when hardened by the ordinary method but which came out all right when given a dose of cyanide just before dipping. However, later on the trouble was overcome by the use of a bath of the form shown in the sketch, having pipes coming up around the side. These pipes were perforated to allow the water to be forced against all parts of the disk, this insuring perfect contact of water with the heated steel. When this style of bath was adopted it was not necessary to use cyanide.

WHERE CYANIDE IS UNDESIRABLE

I have seen hundreds of cases where I was certain that excellent results followed the use of cyanide and I have seen instances, especially where the pieces were thin or where they had light projections, where I was certain that the character of the steel was changed and it was rendered unfit for the purpose; this is especially the case with steel to be used for springs, or similar pieces.

Australian metallurgists claim to have solved the problem of treating refuse zinc ores, of which many millions of tons have accumulated. These ores having been treated for the lead and silver residues, carry 6 per cent. lead, 20 per cent. zinc and 6.3 ounces of silver per ton. A company has been formed in Melbourne, with a capital of $1,750,000, for the purpose of reclaiming metals from these tailings.—*The Metal Industry.*

PATTERN-MAKING AND MOLDING OF CYLINDERS FOR TWO-CYCLE INTERNAL-COMBUSTION ENGINES

"Two-port" and "Three-port" Types—General Considerations of Design—Methods of Cooling—Air-cooling Little Used—Various Arrangements of Patterns and Cores

BY E. F. LAKE

The two-cycle gas engine is divided into two classes, namely: the two-port and the three-port engines. The two-port engine was the first designed, and then, owing to the high speed required for marine and automobile use, the three-port engine was designed.

THE TWO-PORT ENGINE

The two-port engine is called the valveless by some, as it does away with all valves in the engine proper, the gas being drawn by the piston on its upward stroke, through a check valve located in the intake pipe, into the crank case, which is made airtight. The piston on its downward stroke then closes this valve and slightly compresses the gas entrapped in the crank chamber, and when it reaches the lower part of its down stroke, opens a by-pass or intake port and the gas rushes into the compression chamber, driving out the burnt gases through an exhaust port, which is opened a little before the intake port and remains open until after the intake port is closed by the piston on its upstroke, which compresses the gas again, and it is fired when the piston reaches the top.

THE THREE-PORT ENGINE

The three-port engine does away with the check valve and uses a port in the wall of the cylinder at the top, either in the center of the top or in the side wall near the top. This port is usually opened and closed by a valve working automatically, the piston on its down stroke creating a vacuum which draws open the valve, allowing the fresh gas to flow in, and when the piston starts on its return or up stroke it releases the draw on the valve, and it closes with the aid of a small spring. The difference between the two styles is about the same as that between the suction inlet and mechanical inlet of the four-cycle gas engine.

ADVANTAGES AND APPLICATIONS OF THE TWO-CYCLE ENGINE

The two-cycle engine is an eye-sore to the manufacturer of the four-cycle as it is much cheaper to make owing to the fact that it does away with the cam shaft, cams, cam-shaft gears, valve, valve rods, valve springs, etc.; therefore, the point that the two-cycle makers use of its not costing near as much for the up-keep of the engine, it having so many less parts to keep in repair, has a great deal of truth in it.

The two-cycle engine is used largely in marine work, being no doubt the best power at present for the small launch, and it is growing in popularity for automobile use.

HOW THE TWO-CYCLE ENGINE IS DESIGNED

The designing of the two-cycle engine is not as easy as the designing of the four-cycle, as almost anyone with a knowledge of the designing of the steam engine and a little practice in proportioning can design a four-cycle gas engine, but with the two-cycle engine this knowledge and practice is often paid for by expensive experimenting, as the area of intake and exhaust ports and the time that each shall do its work—not only the exact period at which each should be opened and closed, but also the length of time each should remain open—must be worked out very accurately. This has been done by many manufacturers on the cut-and-try plan with the result that engine after engine has been built and then thrown on the scrap pile. In the early days of the gas engine this was the only method to pursue as there were very few rules to go by and many that were made had to be discarded and others substituted, but today there are many men who have accumulated the knowledge and experience which this cut-and-try method has brought out and they are called designers and engineers and are capable of constructing an engine on paper that will operate successfully when it is built. However, with this careful designing must go good mechanical work, as the best of designing can be spoiled by poor mechanical work.

TIMING THE PORT OPENING, AND FIXING UPON SIZE OF PORT

The principal considerations on which a design is to be based are the action of the gases during the cycle, with the speed of the engine when running its slowest and developing full torque as a basis for the time of opening of the ports; and the highest speed which develops full torque as a basis for the width of the ports across the cylinder.

As an example it is not an uncommon thing for a three-port two-cycle engine designed to run at 600 revolutions per minute to hold its full torque at 1100 or even 1200 revolutions per minute.

COOLING THE MARINE-ENGINE CYLINDER

The two-cycle engine cylinder is always water-cooled for marine work, where it is used the most, as a fresh supply of water is always available and it can be water-cooled easier than air-cooled, and with less mechanical parts, and is almost always cooled by having a water jacket cast integral with the cylinder, through which a current of fresh water is kept circulating by a pump.

COOLING THE AUTOMOBILE ENGINE CYLINDER

For automobile use, the two-cycle engine is nearly always water-cooled, as an explosion occurs every time the piston comes to the top of its stroke, so there is a great deal more heat to be carried away by the water than in the four-cycle which has an explosion of the gas only every other time the piston comes to the top or every second revolution of the crankshaft. Therefore, it is considered good designing, by some, to make the area of the water jacket larger in the two-cycle than in the four-cycle. Some, however, keep the area the same and increase the speed of the current of water passing through the water jacket, by speeding up the pump.

Many arguments are advanced to prove that the two-cycle engine is easier to cool than the four-cycle. One of them is that the incoming gas being cool and coming in twice as often in the two-cycle as in the four-cycle it must of necessity keep the cylinder cooler and leave less heat for the water to carry off, but while this is so at the point where it comes in, it is not so the minute it reaches the compression chamber where it explodes twice as often per given number of revolutions as in the four-cycle; or from there out through the exhaust port and passages where more heat is of necessity delivered to the cylinder walls.

This larger area of the water jacket or increase in the speed of the current of water necessitates the carrying of a larger water supply for automobile use when the two-cycle engine is used, which means a larger radiator for the same number of cylinders with the same bore and stroke. But this is more than offset by the fact that the impulses occurring twice as frequently per given number of revolutions in the two-cycle as in the four-cycle, fewer cylinders are necessary to hold the torque constant and for the same horse-power, per given number of revolutions. Thus a three-cylinder, two-cycle engine is the equal in horse-power of the four-cylinder, four-cycle, of the same bore and stroke and some tests have shown a two-cylinder, two-cycle to rate as high in horse-power as a four-cylinder, four-cycle. So that while the volume of water carried would be greater, per cylinder of equal bore, stroke and revolutions per minute, in the two-cycle than in the four-cycle, the volume of water carried would be less per horse-power, as the cylinders could be smaller or a less number used in the two- than in the four-cycle plan, which will hold the same torque and deliver the same horse-power at the brake.

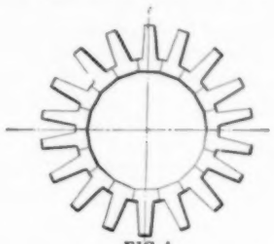


FIG. 4
Showing Construction of Pattern

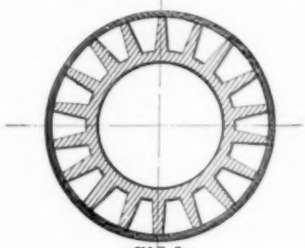


FIG. 3
Section on A A, Fig. 1

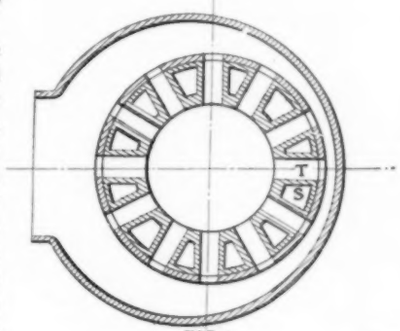


FIG. 2
Section on B B, Fig. 1

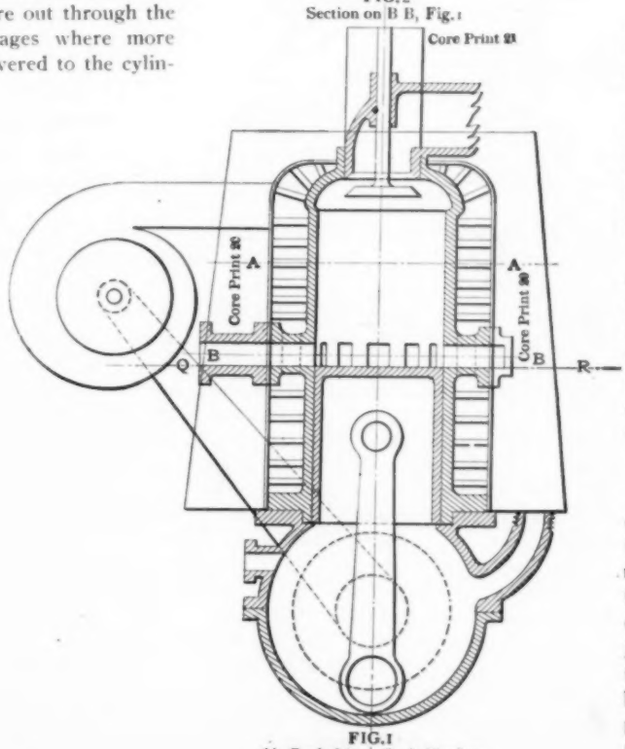


FIG. 1
Air-Cooled Two Cycle Engine

OTHER BENEFITS FROM THE TWO-CYCLE ENGINE ON AUTOMOBILES

It is also possible to do away with the transmission change gears on the automobile by the use of the two-cycle engine, owing to its great flexibility and the use of the reversing engine for backing up. Many of the latter are made for marine use, the adaptation being accomplished by the use of a governor attachment and the moving of the ignition timer.

VARIOUS DESIGNS OF AIR-COOLED TWO-CYCLE ENGINES

A number of different designs of air-cooled two-cycle engines are being brought out at present, which are more or less successful.

One that I have illustrated by Figs. 1, 2, 3 and 4 has a sheet-metal jacket between which and the cylinder wall, which is covered with pins cast integral with it, is forced a current of air by a fan or blower.

Another style of air-cooled, two-cycle engine is that having revolving cylinders, with flanges about ⅛ of an inch thick and from 1 inch to 1½ inch wide, covering the entire cylinder and cast integral with it. By the revolving of the cylinders they create their own current of air and are cooled by it.

THE OBJECTS AIMED AT BY THE DESIGNER

Many different ways are adopted by the designers of the two-cycle engine cylinder in order to make the pattern-making, molding and machining easy; while others try to design the cylinders so as to reduce as much as possible the number of joints, which might cause a leak and spoil the effectiveness of the engine. As an illustration, some cast the cylinder and upper half of the crank case in one piece as shown in Figs. 5, 6 and 7; this makes

much more work for the patternmaker and molder and makes it more difficult for the machinist to bore out and grind the cylinder for the piston, but it does away with the finishing and packing at the joints which others use.

Some cast the cylinder in one piece as shown in Figs. 8, 9 and 10 and then bolt it to the crank case. In this case where more than one cylinder is to be used in an engine, the crank case can be cast in one piece and two, three or four cylinders, as the case may be, bolted to it. In this style the cylinder is easier to bore and grind and the crank case is more substantial being in one piece, but the bottom of the cylinder and the top of the crank case must be machined and a tight packing put in, since in the two-cycle engine the crank-case compression is from four to eight pounds per square inch. Some make the top of the cylinder, that is above the line *A B*, Fig. 5, in one piece and the lower part of the cylinder and upper half of the crank case in one piece, that is below the line *A B*. This style requires machining and packing at the joint on the line *A B* which must be very tight as it has to stand the explosion and expansion of the gases which drive the piston, but it makes it much easier to bore and grind the cylinder as both ends are open and it makes it much easier to mold and make the pattern of, as the water-jacket core can be located in a print which goes around the entire pattern at the line *A B* and the cylinder core can also be located in a large print on the same line and the cylinder cast on end easily, which would result in fewer castings being lost.

Others cast the cylinder in two pieces, making one casting of the top above the line *C D*, Fig 8, and another casting of that part of the cylinder below the line *C D*. This makes the patternmaking, molding and machining of the cylinder still easier as the pieces are smaller and easier to handle, and both ends of the cylinder are open, making it easy to bore, the cores easy to set, and the core-boxes and patterns easy for the patternmaker to make, it is also less costly to replace a cylinder when one wears out, but it makes a joint at the compression chamber on the line *C D*, which must be machined very accurately and two packing rings of an equal thickness inserted, one between the compression chamber *E* and water jacket *F*, Fig. 8, to prevent the gas from going out when it explodes with a maximum pressure of from 250 to 300 pounds per square inch, or the water from coming into the cylinder and disturbing the action of the gases and piston. The other packing ring is between the water jacket *F* and the outside of the cylinder. Another joint is also necessary between the cylinder and the crank case, but this is not as important as the one on the line *C D*, Fig. 8, as the pressure is nowhere near as great. These joints also add to the weight of an engine as extra bosses are added to the casting for the bolts and extra studs or bolts; and nuts are added which might become a source of trouble from working loose. Each style therefore presents good and bad qualities, and it is up to the buyer to select the one which suits his ideas or his pocketbook the best.

THE ELMORE CYLINDER

Figs. 8, 9 and 10 represent the type of two-port, two-cycle engine for automobile use, used by the Elmore Manufacturing Company, of Clyde, Ohio, which has given much satisfaction. This style can be molded by being parted on the center line *G H*, Fig. 8, and the lower half of the water-jacket core placed in the mold and located by core prints Nos. 1 and 2, Fig. 9; besides this it would be necessary to support the core by chaplets, which is poor practice, where they can be avoided, owing to the liabilty to cause a leakage around them as they do not always fuse with the iron when poured. The use of chaplets could be overcome by cutting holes for the core through the outside cylinder wall at 4 and 5, Fig. 8, and locating it with core prints at this point. These holes could afterward be plugged or plates fastened over them with screws. The center or cylinder core could then be placed in position by locating in core prints 3 and 6, Fig. 9. At core print 3 it would be advisable to use a perforated iron pipe running entirely through the core, owing to the core print being so small a support for such a large core; this pipe could also serve as a vent to the core. Then by locating in the mold an iron plate, with a half round in it to fit the pipe, the core would remain in position, and not settle, and cause thin metal on the lower sider of the casting and thick metal on top. The core that forms the exhaust passage could then be located in core print 7. The core that forms the passage for the gas to enter the crank case could be located in core print 8, and the core that forms the by-pass for the gas from the crank case to the compression chamber could be located in core print 9. Core prints 7, 8 and 9 should be long enough to balance the cores so they would not tip in the mold. Then by placing the top half of the water-jacket core on and pasting it to the lower half, the mold is ready to close and pour the iron in.

THE "THREE-PORT" CYLINDER

Figs. 5, 6 and 7 illustrate the three-port, two-cycle type; so far as the cylinder is concerned there is very little difference, and this one can be molded in a similar manner to the one just described, or both could be molded on end. I will describe the molding of this one on end, which could be applied to the one described above by a few changes in details.

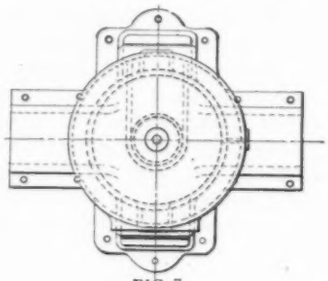


FIG. 7

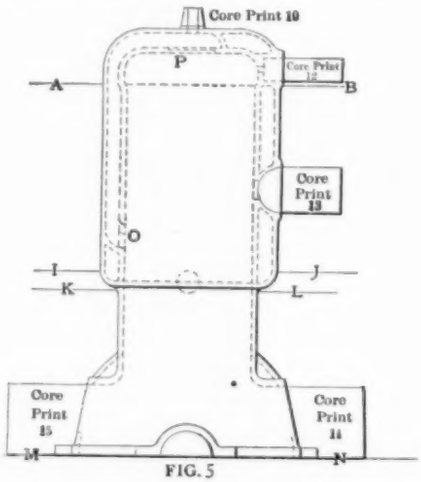


FIG. 5

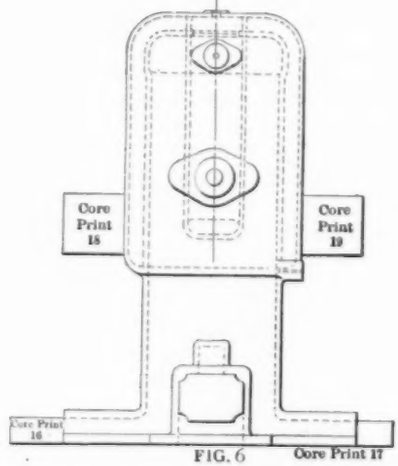


FIG. 6

WATER-COOLED TWO-CYCLE ENGINE CYLINDER, "THREE-PORT" TYPE, CAST INTEGRAL WITH UPPER HALF OF CRANK-CASE

In order to mold this on end, it would have to be done in a three-part flask. This could be done by parting the pattern on the line *K L*, Fig. 5; the mold would have to be parted on the lines *I J* and *M N*. After the pattern was drawn from the mold, the cores which form the opening for the spark plug at core print 12, and the opening for the exhaust at core print 13, could be placed in their respective places, and by making them shorter than the core print, they could be pushed back in the mold until after the water jacket and cylinder cores were set, and then from the outside of the mold they could be pushed in until they touched the cylin-

der or center core. The water-jacket core could then be lowered in and located by core prints 18 and 19, Fig. 6. The center core could then be lowered in and located at the bottom by core print 10 and at the top by core prints 14 and 15, Fig. 5, and core prints 16 and 17, Fig. 6. These prints would carry all the weight of the core, so that core print 10 would merely locate it at the bottom and prevent the core from washing to one side or the other. Integral with this core would have to be made the by-pass core, which connects with it at *O* and *P*, Fig. 5.

MAKING THE CYLINDER FOR AN AIR-COOLED, TWO-CYCLE ENGINE

Figure 1 is an assembly view of an air-cooled, two-cycle gas engine and Figs. 2 and 3 are sectional views of the same. There are not many air-cooled, two-cycle gas engines on the market at present, and none that have come info prominence as they are still in the embryo state, but there are many experimenting with them and some practical ones may be brought out before long.

As this article is only dealing with the cylinders, I will confine myself to that alone and not describe any of the other pieces shown. About the only way that this can be molded successfully is to inclose the whole pattern in a core box as shown by core print 20, Fig. 1, then it will be necessary to make this outside core in two parts, splitting it on the line *Q R*, in order to get in the core the air passages at *S*, Fig. 2. These passages allow the air to circulate past the exhaust chamber which is located at the line *B B*, Fig. 1, also to get the exhaust passages which are located on the same line and are shown by *T*, Fig. 2. These exhaust passages are around the entire circumference of the cylinder and are carried out through the air jacket by a flange-like arrangement over which is fitted a ring that has an opening at one side to carry away the exhaust. This ring also serves to hold the sheet-metal water jacket in position at this point. The outer wall of the cylinder being covered with pins cast integral with it, it is necessary to build the center of the pattern barrel shape and then pin to this barrel loose staves as shown in Fig. 4, each stave to take care of a row of the cooling pins which are cast on the cylinder; then a ring can be built on the top of the core box which makes the outside core above the line *Q R*, Fig. 1, with the air passages *S* and the exhaust passages *T*, Fig. 2, in it. After the core is rammed up, this ring is taken off, then the center or barrel of the pattern is drawn out of the core box and the staves with the cooling pins on are drawn into the center of the core and out, leaving the core ready to dump out of the box. The same operation is gone through with in making the outside core below the line *Q R*, Fig. 1, except that in this ring there is only a part of the air passages *S* to be taken care of, the exhaust passages all being made in the other core box.

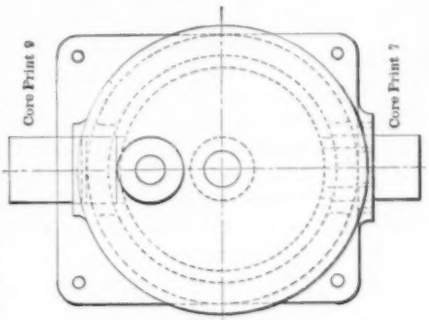


FIG. 10

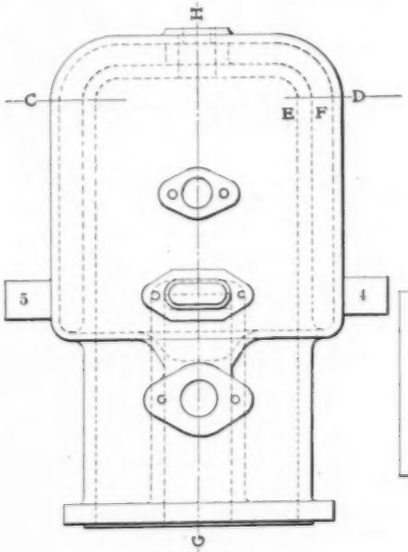


FIG. 8

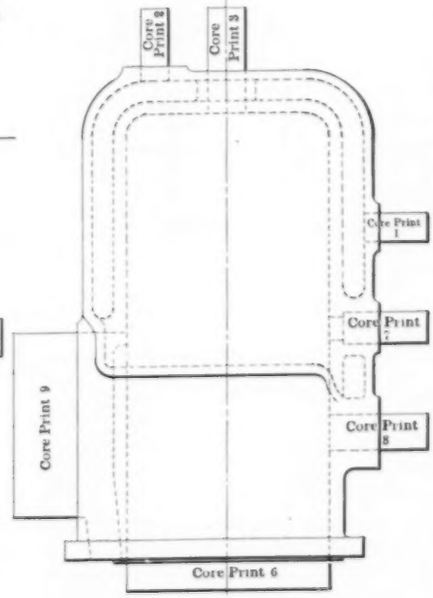


FIG. 9

WATER-COOLED TWO-CYCLE AUTOMOBILE ENGINE CYLINDER, "TWO-PORT" TYPE, CAST SEPARATE FROM CRANK-CASE

In molding it after the plain round pattern, built to the outer line of core print 20, has been drawn from the sand, the outside core above the line *Q R*, Fig. 1, is lowered into the mold, then the center core is lowered in and located by core print 21 at the bottom and another core print at the top for the cope to lower down over, then the outer core below the line *Q R* is placed in position and pasted to the other part as shown above the line *Q R*, whereupon the mold is ready to close and pour.

The molding of this in dry core sand will insure the iron flowing more freely and give a better casting than if it were molded in green molding sand and it would give even better results if the mold were placed in the core oven and warmed just before the iron was poured in.

Compressed Air in a Foundry

With the rapid growth of the General Electric Company's plant in Schenectady, the iron foundry has been enlarged and equipped to handle an immense output. The additions to the main building and the cleaning room make the main structure 880x140 feet, with a wing 170x120 feet; besides which the gantry crane covers a 50x450-foot flask-storage yard. The employees in this shop now number 1030; the building contains 214,000 square feet of floor space; number of cupolas, 5; tons of castings produced a week, 550; number of castings produced a week, 45,000.

Compressed air is found to be a valuable labor-saving agent in the iron foundry, and it is now utilized in nearly every operation connected with the making of a casting. Throughout the company's mammoth plants, electric distribution of power is, in general, used to run the machinery, either by individual drive or by group drive. But in the iron foundry where the operations are scattered and intermittent, compressed air was found to be advantageous for small power service. While the work in this department is actually done by compressed air, the air, in turn, at 80 pounds pressure, is supplied by a number of electric-motor-driven compressors of various capacities. A compressor of 1700 cubic feet a minute capacity, driven direct by a 225 horse-power motor, renders the iron foundry independent of the general compressed-air service. On the main floor 63 Tabor molding machines in constant use are driven by the compressed air. The cars in the eight core ovens are operated back and forth in the same way. The jib cranes are equipped with compressed-air lifting cylinders, greatly facilitating the handling of flasks. Compressed air operates the blowers in the cupolas where the pig iron is melted, the heating and ventilating fans, the sand-blast apparatus, and the pneumatic chipping tools for dressing castings for delivery to the machine shops.

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Numbering Counter Wheels

An article of mine, entitled "A Turret Lathe Job," published at page 785, Vol. 28, Part 2, closed with the remark: "The numbers are put on the wheel in a later operation." Circumstances have been such that it has been impossible to explain the number-stamping operation until the present moment, but perhaps it may now make an interesting sequel to the article mentioned.

The accompanying drawing shows the fixture complete. It is, however, made entirely from memory, and is not true in design to the original, though it covers entirely the principles involved. Doubtless it will prove sufficiently clear to serve as the foundation of a properly designed apparatus to answer the purpose desired.

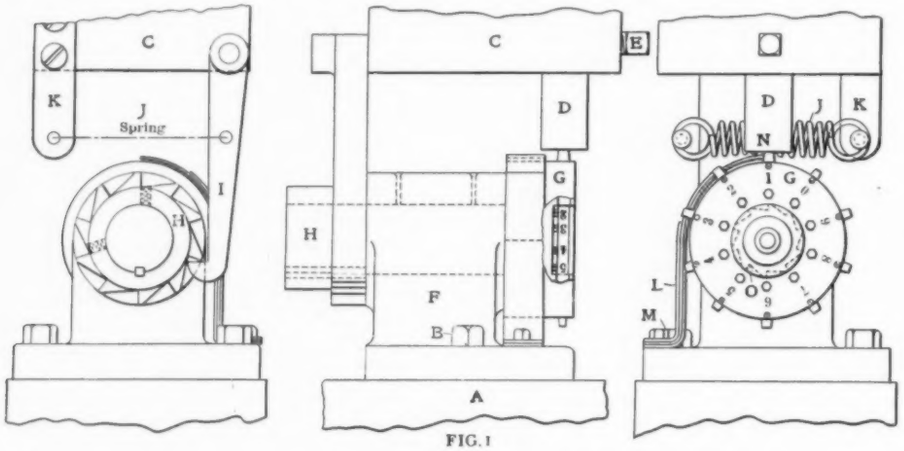


FIG. 1

DEVICE FOR NUMBERING COUNTER WHEELS

CONSTRUCTION OF THE FIXTURE

The fixture is intended to be used in conjunction with the power press. Referring to Fig. 1, *A* represents the bolster plate of the press, to which the fixture is bolted by the cap screws *B*. *C* is the press plunger, and *D* a hammer, or ram, placed in the socket ordinarily occupied by the punch, and held securely in place by the set screw *E*. *F* is the base and bearing, and needs no other description than the sketch itself. *G* is the spindle and anvil, and is constructed and operated as follows: on its end is keyed the ratchet *H*, which has ten teeth (the number possessed by the wheel to be stamped) and is actuated by the pawl *I*, the pawl being fastened to the plunger *C*, and kept against the ratchet by the spring *J*, attached to the projecting piece *K*, which is also screwed to plunger *C*. *L* constitutes a series of flat springs so shaped as to conform to the contour of the anvil head *G*, and held in place and in tension by the cap screw *M*. Fastened to the underside of the springs *L* is a strip of leather *N*, which bears hard against the surface of anvil *G*.

THE WORK AND THE STAMPS

The wheel to be stamped is shown in place in the fixture. A small pin *O* contacting with one of its ratchet teeth does the driving. The auxiliary punches, or stamps, and the method of their retention, are more clearly shown in Fig. 2. The point of the stamp is concaved to make perfect contact with the periphery of the wheel to be stamped, and on this concaved surface the figure is sunk. The spring *P* is first dropped into the recess, and on this is placed the stamp. The collar *Q* holds all in place, and is itself retained by the set screw *R*. The pivot-point screw *S*, entering the slot *T*, keeps the stamp in perfect alinement.

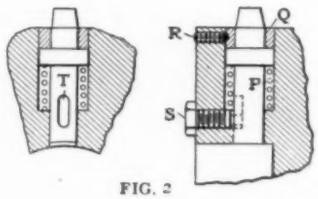


FIG. 2

The counter wheel is placed as shown with one of its teeth against the pin *O*, and is held in place, sidewise, by the finger of the operator. Some of the boys use a piece of wood or leather to prevent unnecessary wear on the finger.

OPERATION OF THE DEVICE

In the sketch the press is shown in the act of stamping numeral "1." The foot of the operator is now on the tripping pedal. As the plunger rises, carrying punch *D* with it, the pawl lifts the ratchet *H* one tooth. The springs *L*, acting as a brake against *G*, prevent the head from turning farther than rotated by the pawl and bring numeral "2" under the hammer *D*. The operator keeps his foot on the tripping pedal until the tenth numeral, or "0," has been struck, which causes the press to stop with the plunger up, preparatory to striking numeral "1." However, the plunger may be stopped or started at any point, the operator allowing the auxiliary punches to be struck but once, by observing the position of the figures stamped on the side of anvil *G* before removing the foot.

This fixture has been in use for some years, and has successfully stamped several thousand wheels. C. H. RAMSEY.

More about the Inventive Microbe

"Necessity is the mother of invention." "New Yorker" got after the motherless inventions in good shape at page 749, but what about the other kind?

I got stuck once out in a country machine shop with a planer. It was one of these old affairs with a cannon-ball belt shifter. Most of you will recognize the name. The table, gearing and pulleys were so light that it would not shift over to the return stroke without outside aid, so they put on a cannon-ball, which was lifted up by the dog and then dropped over on the other side to finish shifting the belt. The completeness of the design on this particular planer will be evident when I tell you that the cannon-ball was set just right to break the operator's leg, if he sat down to run the planer. Well, that is not what I started out to say. I was going to say that I wanted to do a

pretty good job on this machine, but could not because the cross rail was worn so that it curved upward on the bottom and down on the top a full sixteenth of an inch. I couldn't get the thing planed because there was no other planer available; and besides, the owner knew the planer was all right, for he had had it twenty or thirty years and if there was anything the matter he would have found it out. So the only thing I could do was to fix it myself. I had a scrap heap—all up-country shops have them; Dixie has no mortgage on them. I took two pieces of railroad iron, otherwise iron T-rails, strapped them across the posts, strapped the head to these rails and went ahead and planed up the cross rail. Of course, it was a little slow. I had to set the head over horizontal and set the tool up to the cut with a hammer, and once, when I had it almost done, I used too much hammer and knocked the whole business down; but that was only an incident.

Now that was invention, just as much as if I had a patent with the government seal on it. It was brought about by necessity. Every man who has knocked around a small shop has invented things on an average of once a week. Every little while he has to stand round and see someone else reap the reward of his work either stolen or re-invented. There is a taper attachment for a lathe, which is on the market, patented and successful, but which I invented and built years before the owners of the patent invented it. I got it up because I had to, not having money enough so that I could buy or safely steal anything that was on the market. There is a turret lathe on the market, whose principal feature was used and is used by a chuck manufacturer, who could, if he saw fit, knock the props out from under the turret lathe man. He did not invent this thing as a result of a study of turret lathes. He invented it because he had to have something to do certain work. He did not realize its value as applied to any other work except his own. And so it goes. The best part of inventive ability does not go through the patent office. Inventions are made because they are needed, and as they are needed. One invention is made as a sequel to another. The man who sits down to deliberately invent something that will prove a money-making venture is almost sure to land in a hole. The man who sets out to make a certain machine to do a certain thing, and who sticks to it, is almost sure to do some useful inventing.

The patent office, if the truth could be known, bears about the same relation to real business that the bucket shops do to the real buying and selling of stocks. With few exceptions, patents are taken out as speculations. A man of my acquaintance got the "get-rich-quick" bee in his bonnet. He tried the bucket shop, but couldn't make it go. So he set out to invent something. Of course, he knew that there was no money in any invention in his own business—we all know that; so he set out to invent something that he didn't know anything about, which is just what all conscious inventors do. He got up a soap holder—a perfectly practical soap holder, if anyone wanted to hold soap; and he got a patent on it. Now he is wondering why he didn't go into the kitchen and watch his wife wash dishes once or twice before he got his patent.

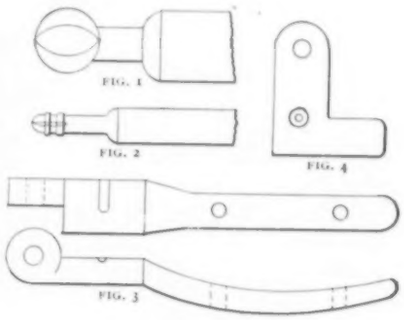
But the unconscious inventor—the man who invents because he must, or because it is easier to invent than to copy or even find out what others have done—he is the man that has made this country what it is commercially and mechanically today. Don't let's discourage him, "New Yorker," don't cut his head off. We need it as much as he does.

ENTROPY.

Making Bullet Molds in a Jobbing Shop

When one is running a small repair shop "far from the madding crowd," there arise many small problems for quick solution. These vary from making a stingy farmer understand that you cannot and will not drive ten miles to fix "just a screw out of place or something" on his thrashing outfit for a dollar, or in fact for any set price before seeing the job, to getting a bullet out of little Willie's $1.75 22-caliber rifle, so that said Willie can catch up to the rest of the boys who are anxiously looking for squirrels, while talking about bears, wolves, etc.

A job we not infrequently were up against was the making of bullet molds. Farmers would lose the mold that went with their trusty (?) old muzzle-loaders, and would come around to me, sounding, as it were, to find what the cost of a new one would be. I had my price, which was $3 for a single mold, i.e., a mold which would make but one bullet at a time. They would bring me catalogs, and show me that a better mold, only of a different caliber, could be had for one dollar. I always assured them that they were more than welcome to get their molds elsewhere, as my profit on one was not so great that I begged to make many. The first thing to be done after Si. had decided he really wanted a mold more than the $3 was to get the gun, and if possible a bullet from the former mold, though this last was more to get the shape of the bullet like the old one, so that Si. would not think he was being buncoed because the point did not have the same slant. Then I made a cherry the shape and size of the bullet on the end of a round bar of tool steel, this being then fluted, relieved and tempered. At first I made molds out of wrought iron, bringing them to shape on the anvil, but this was "too much for the money," so I made a pattern and had a couple of dozen cast of gray iron at the nearest foundry. The bodies of these were large enough to accommodate any ordinary-sized bullet; but, sure enough, about a week after I got them in, along comes a grizzled old chap from the hills wanting a mold for a slug big enough to designate its size by inches, like naval guns. It was a ball he wanted. Fig. 1 shows approximately the shape of the cherry I made for its manufacture. I, of course, had to forge the mold parts, as the cast ones were out of the question. However, I got well paid for my trouble as the old fellow had no cash, and gave me a couple of beaver skins which I sold at a price I would be ashamed to relate—it would make the reader think of bead trading in the Indian country. After drilling and putting in the pin that holds the two parts of the mold together, and getting the faces straight so the lead wouldn't stick out like wings on the sides of the bullet, I drilled a hole with its center in the joint between the two halves



MAKING BULLET MOLDS

(about ¼ inch for a 44-caliber bullet) and, revolving the cherry in the lathe, squeezed the handles of the mold until the faces were together, of course seeing that no chips were between. It would have been a long job to flute the cherry for the large slug with a file, so I put several rough centers on the ball and, starting the tool in at the nose, pulled the cherry around by hand, in much the same fashion as turning a solid wrist pin in a cross head. I must confess the flutes were few and far between, but so were the dollars, and anyway it did the job. The next item was the cut-off plate pivoted on the single connecting pin, and made of saw steel, shown at Fig. 4. The last operation was to put on a pair of wooden handles. Generally about the time I got to this the three dollars were so far gone (counting fifty to seventy-five cents per hour) that the artistic appearance of the job suffered considerably. Fig. 2 shows the usual cherry, Fig. 3 the cast molds.

While I am writing of that shop I might say that the best paying job which came in was the drilling and tapping of bicycle cranks. Dozens were brought, first to the

blacksmith, who after welding sent them to me. I drilled and tapped the hole for the pedal pins (½ inch by 20 threads) in about three minutes and got twenty-five cents each. W. L. McL.

Canada.

Making a Fly-wheel in a Hurry

One method of making a "hurry up" fly-wheel (so called because the making of a full pattern would cause too much delay in getting the casting, or too much expense in the pattern shop if only one or two castings are required) is described in this article. By this method the casting can be in the machine shop on the third day from starting the pattern.

At first sight, it may seem a case of saving the pattern shop at the expense of the foundry; but by actual time, one molder put this job together ready for casting in five hours, and the making and finishing of the cores took less than five hours. As a molder usually takes a full day to mold a wheel of this size in green sand, the labor cost is almost the same, the extra expense in the foundry being in the sand and material burnt up in the cores, and possibly a little more chipping in the cleaning department. Whether this be less or more depends on the finish of the green-sand mold. Thus, while the foundry expense in making this fly-wheel is but a fraction more than molding from a full pattern, the pattern shop expense is less than one-fourth.

I do not advocate this method as a standard, but only for emergency cases, as I believe that any additional cost in the foundry should be avoided on standard work, as when multiplied by the number of castings made, in the aggregate the loss is great. At the same time it is the combined cost in both departments that should be considered.

The method is simple and needs little explanation in addition to the drawings

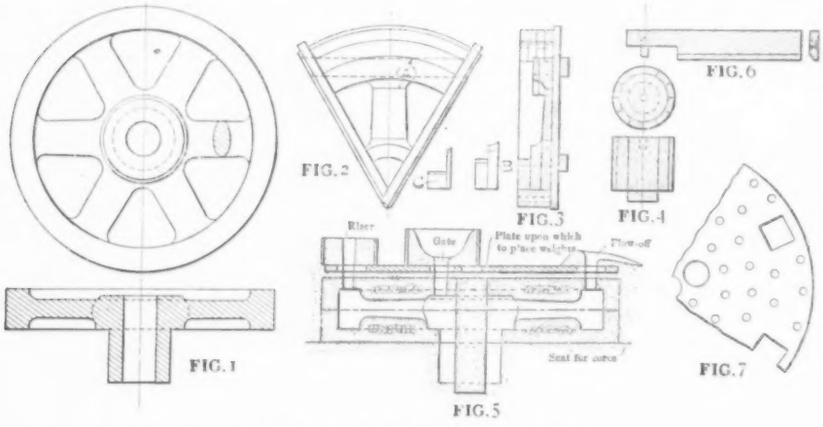
Fig. 1 represents a 40-inch fly-wheel to be cast.

Fig. 2 is a plan view of the core box, arranged for the six cores; for the drag half of mold. The segment *A* should be loose in the box for convenience in finishing the core. Of course the cores could be made with this fast in the box, but being loose it saves both the coremaker's time and the patternmaker's reputation.

Fig. 3 is a sectional view on the center line, showing the construction of the box. To change for the cope half of cores the piece *B* is taken out of the box and the piece *C* is inserted in its place. One of these cores should be provided with holes for the gate and riser as shown in Fig. 5, and another core, to be placed opposite this, with a hole for flow-off, the other four cores being left plain.

Fig. 4 shows the construction of the long hub, the making of which may be a long or a short job, according to the patternmaker's accuracy in using his machine tools. It is well, sometimes, to saw *to the line*.

Fig. 6 shows the sweep for making the level bed or seat for the cores.



CASTING A FLY-WHEEL IN A HURRY

Fig. 7 shows a section of the plate to lay on the cores, upon which to place the necessary weights to secure them while pouring the casting. These, or similar plates, can usually be found in the common stock of the foundry.

Fig. 5 shows a cross section of the cores and general arrangement of the mold. A hole of sufficient size is dug in the foundry floor. The hub, Fig. 4, is placed in position, leveled and rammed up to the line given by the placing of the sweep, Fig. 6, in position at the center of the hub. When revolved this gives the seat for the cores, on which the drag halves are placed abutting the hub as shown. The hub is then withdrawn and the center core placed, and the cope halves of the cores set in alinement with the drag halves, the cores all being in position, and secured by ramming around the outside to the top. Sand, about one inch thick, is thrown on them, and above this the plate is placed, the gate riser and flow-off being arranged as shown.

The whole is sufficiently weighed in the usual way, and the mold is completed.

JABEZ NALL.

An Antitoxin for the Inventive Microbe

Most medical men agree that the human body is infested with various microbes, bacilli, parasites, etc., some of which are considered as inimical to health and others necessary to maintain it.

This analogy is mentioned by New Yorker, in an article at page 749, the trend of which is to discourage what we may call the *patent parasite*, as being detrimental alike to the mind and pocket of the party infested by them.

It is suggested that if the party suffering from such cause could be inoculated with the proper amount of *business bacilli* the combination would become an eminently happy one.

It is not considered, by any means, as advisable to discourage inventive genius, for it is the consensus of opinion of people worthy of consideration that the present prosperous condition of the country in general is largely due to the inventive ability of American citizens.

It is, however, an unfortunate fact that inventors seldom possess a desirable degree of business acumen; they must be classed, generally, as intelligent, but not necessarily as educated or refined, and seldom as experienced. Ideas come alike from the lowest grade laborers to university professors, but ideas alone will never make their possessor rich in any sense of the word. Without the business ability and knowledge how to dispose or employ the products of their minds, they are of little use to them. In fact, they may be, as indicated in the article mentioned, even detrimental.

A case known to me indicates how this may happen. An inventor, a graduate of a well known university, and holding a responsible position in the engineering department of a large manufacturing company, devised a certain mechanism, which was considered of sufficient merit to be taken up by the company; the device was manufactured, advertised and some were sold by the company when the inventor took the matter to a friend, a patent attorney, had him make the usual preliminary search in the Patent Office, decide upon the patentability, formulate his application and enter it in the Patent Office.

Almost as soon as this last step had been taken, the manager of the company employing this inventor, not knowing of this, called him into his private office, and made him an offer of a certain sum in cash, to be paid then and there, to pay the entire expenses of the patent to be obtained, and, further, an additional increase in the amount of his salary, provided the company was assigned rights in the invention.

The inventor, in place of accepting the offer for what was, at that time, a practically untried and undemonstrated device, said to the manager that he was unable to accept the proposition, as he had already made an application for a patent on the invention.

The result of several consultations between the two parties was that the young man lost his position, the invention was withdrawn from the market by the company, and, in place of proving a success, which it undoubtedly would have done, it has been practically obscured and is likely to be of no further use to the inventor or anyone else.

The wisdom of the inventor's attempt to control the matter alone is questioned. On the other hand, the act of the company's manager in refusing to consider what to the inventor was a fair proposition, and his immediate discharge of the inventor on account thereof, makes a subject for reflection.

Here is a case where a few extra *business bacilli* in the brains of both parties might, and in all probability would, have been of value to both.

That thinking men do invent and profit by their inventions is evidenced by the fifty thousand applications which are entered in the United States Patent Office annually, and that business men find it profitable to protect themselves by such measures is evidenced by people well known in business life, such as Thomas Edison (with something like six hundred patents), George Westinghouse, and many hundreds of others, well known to mechanical fame.

It is suggested to your readers that, should they find themselves afflicted with "ideas" and believe they have invented or discovered something which is likely to be of value, they try the thing out, if it be possible to do so, before the expenditure of much money on them. If they still persist in their belief, it might be advisable to consult entirely unprejudiced parties regarding the matter, for, notwithstanding the common contrary opinion, it is fairly safe to say that they can do so with reasonable safety to themselves and their rights in the matter. Few ideas or inventions are stolen; so few, in fact, that in an experience of twenty years, not one well authenticated case has occurred to my knowledge.

After the matter has been worked out to this extent, take it to a patent attorney, who is possessed of a knowledge of that particular matter to which the invention relates, if it be possible to find one. Here is where many people make an error in selecting a cheap attorney, who, perhaps, advertises to do something for nothing, and who is poorly equipped, by practical experience in mechanics, or in fact, in any other valuable branch, except in extracting the unwary dollar.

As most inventions consist of a mechanical element, the attorney should possess a mechanical experience, something of a more practical nature, in fact, than can be obtained by mere theory or book learning. Such men do exist, and are able to give results for value received, but the mere lawyer is seldom well equipped for this class of work. No manufacturer, in his right mind, would, for a moment, entertain the proposition of securing a lawyer to write up a trade circular, descriptive of some new mechanism, but would go to a mechanic, engineer, or someone familiar with such matters, and it is equally true that he should go to a similarly capable person regarding his patent application; for the specification is absolutely nothing but a correct technical description of the subject matter of the invention, while the claims consist in setting out tersely and clearly the strong, salient points therein.

Another matter to be very carefully considered is the probity and honesty of the selected solicitor. If he be capable his opinion is to be regarded as valuable. Ordinarily, however, the attorney feels that he must, in courtesy to his client and in view of the compensation likely to accrue, speak favorably of the invention whether he actually thinks that way or not. For it is a well known fact among attorneys that a candid expression of opinion—provided they are competent to form one—in many cases would so discourage the prospective applicant that he would either stop in the matter, or, what is far more likely, go to some other attorney, who would, with guile and flattery, cause him to believe that he had only to go ahead in the matter to acquire a fortune. Here is where again the business bacilli should come forward and be helpful in overcoming the patent parasite. Could this be accomplished the sad thought that 95 per cent. of inventions are entirely valueless would be changed for the betterment of the inventor.

WARREN E. WILLIS.

A Spider Support for Cone Pulleys

The illustration shows a very handy support for cone pulleys to prevent chattering while being turned. The contact points of the rods are flat as this shape conforms best to the unevenness of the castings.

GEO. J. HUTCHINS.

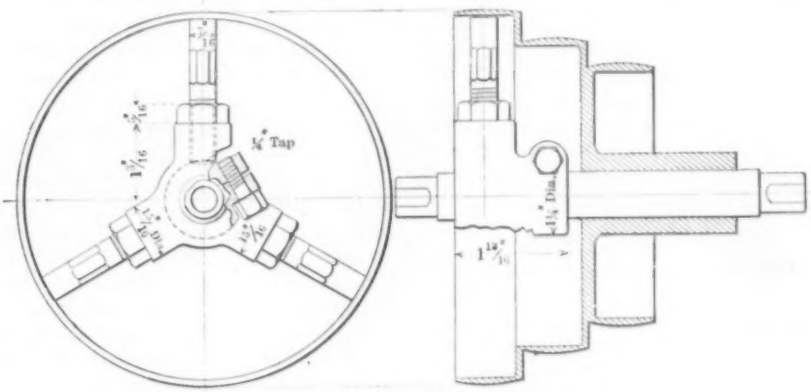
"The Specialist versus the All-around Man" — Tailstock Design—Bearings

I once worked under a foreman who had been a specialist and while he was a clever man he seemed to think the all-around man was capable of doing nothing but rough work and as I was on the repair work at the time he took charge, he seemed to think me capable of nothing else, until he was caught in a pinch once and neither knew how nor what to do.

Then was my chance to show him the capability of an all-around man and I did it in such a way that he received the honor and I his esteem.

TAILSTOCKS AND DRILL SOCKETS

Much has been said about tailstocks but my experience with modern machines shows me that the center gives the most trouble especially where they use drill sockets in the spindle. I have seen spindles so badly scored that you could shake the center with the hand when driven home. Hence, I claim that a drill socket for the lathe should be a socket turning loose within a socket, with a square for a wrench, long enough to ride on the tailstock shear.



THE SPIDER SUPPORT FOR TURNING PULLEYS

A RIGHT-HAND SCREW WANTED FOR THE TAILSTOCK

Another thing that manufacturers make a mistake in is putting a left-hand screw in the tailstock spindle. We use flat drills a great deal in our shop and in the case of a tailstock with a left-hand screw, the operator must either lift on the wheel or go to the back of his machine in order to "lift down," which is by far the easiest way.

THE CLAMP

Another weak point is the cross-bar. It should have a guide projecting down from the tailstock in such a way, as to prevent the swing of the bolts allowing a

slippage which occurs in the machine of today when put to a severe strain.

FINISHING A BEARING

A. Miller, writing at page 642, wishes to know if the draw-filing of a bearing is considered good practice in America. I do not think it is, at least it is not adopted except in extreme cases, probably because it is expensive and again there are a great many mechanics who could not draw-file a shaft accurately, therefore the result would not always be satisfactory. In finishing a bearing I usually slide the polishing clamps one way and that the opposite direction to the tool cut.

JOURNAL TROUBLE CURED BY DRAW-FILING

In testing a special machine we had trouble with one journal which was two inches in diameter and run at 500 revolutions per minute in a bronze-lined bearing 6 inches long. There was a heavy downward strain, and the oil groove was along the entire length of the cap, which was a mistake.

My first effort consisted in plugging the oil groove at each end. This partially remedied the trouble. Next I concluded the journal was not smooth (though it seemed to be) for it chased the oil out of one end of the bearing, like the one Mr. Bell speaks of at page 645. I then removed the shaft and started for a lathe. Every lathe in the shop had a job in it so I decided to draw-file the journal. This produced the desired result.

PROPORTIONS OF BEARINGS

I do not believe with Mr. Bell that the bearing should in length be only twice the diameter, especially for journals below 4 inches.

I have in mind two emery wheels in a shop where I was once employed. The spindle for one had a 1½-inch journal 7 inches long. The other spindle had a 1¼-inch bearing 4½ inches long. Both carried 18-inch wheels. In my two years in this shop, the one with the 1½x7-inch bearing needed no repairs; while the other had to be trued up in the lathe twice, and be rebabbitted about every two months.

SALT ON A HOT BEARING

Another incident occurs to my mind. A large Corliss engine was heating in the out-board bearing, and, on being called in for consultation, I asked for a shut-down, when there arose a terrible howl. "Can't stop! at least not more than ten minutes." I accepted this time limit and proceeded to remove the cap.

Upon doing so I found the journal badly creased. Had I had the time I would have draw-filed it; as it was I sent out for a handful of common table salt, which I threw on the journal and bolting the cap down tight told them to go ahead. The result was all that could be desired.

I would not advise anyone, however, to try this on anything but a babbitt bearing. I did once and the result was disastrous.

OIL GROOVES

Like Mr. Bell I believe that an oil groove along the top is a mistake, but I do not think the groove should be in the journal. I have obtained the best results by having an oil hole in each end of the bearing, and chipping the oil groove in a wavering, downward direction to the bottom nearly at the other end of the bearing. Start at the other oil hole and cross over to the same point at the opposite end of the bearing. Do this on both sides and you will have a bearing that will lubricate no matter how much of a load it carries.

BABBITTING

We used to babbitt our engine and other shafts to the bare shaft and then file and scrape to a fit. One day we had a job which had to be done in the least possible time, as the Old Man had taken it at a very low figure. I decided to economize on the babbitting. I took a sheet of thin wrapping paper, wrapped it around the shaft and tied it with twine just outside the bearings, then poured the babbitt and was astonished at the nice smooth result. The job was put together without scraping, and never gave any trouble.

I have used this method more or less for the last ten years and it has always given satisfaction. A GREASER.

Reboring a Large Sheave

I'm a kicker for facts, and after reading H. D. Pomeroy's article "Reboring a large sheave," at page 676, it occurred to me that the article would have been more satisfactory and of more benefit to seekers for information, if the size of cut taken had been mentioned, also the shape of the cutter. These points sometimes hold the balance between success and failure.

Did he cut all of a large keyway out at one cut? Was the hole enlarged ⅛ inch, ¼ inch, or what? E. J. BOWERS.

Hand-wheel Rims

It is very strange how we miss things that are right under our noses and hunt busily after things miles away. Our shop uses probably five hundred hand-wheels a year, varying from 3 to 24 inches diameter. We made them of cast iron with a 1- or 1¼-inch rim and polished them very nicely. Of course you can turn, file and polish the outside in the lathe, but in between the spokes we had to depend on a file and strip of emery cloth.

I have knocked around the shop a good bit, have put my O. K. on drawings with these nicely finished hand-wheels for a long time; and I would probably be doing the same thing now if someone hadn't come along and suggested that it was a fearful waste of time to finish the inside of the rim by hand, and also intimated that up-to-date machine tools did not have any such foolishness. Of course when some fellow comes along and kicks you good and hard you begin to pay attention. I at once took my elbows off the desk and strolled out into the works. Sure enough there were hand-wheels in every direction and on the latest tools no attempt had been made to finish the inside of the rim, and stranger yet they looked the nicer for it. To the discerning eye unnecessary finish is a blemish. We had been finishing our wheels as shown at Fig. 1, that is three-quarters in the machine and one quarter at *A* by main strength and clumsiness.

On the Brown & Sharpe machines a similiar effect was obtained by making that last quarter, at *B* Fig. 2, slightly depressed and filling it with enamel. Of

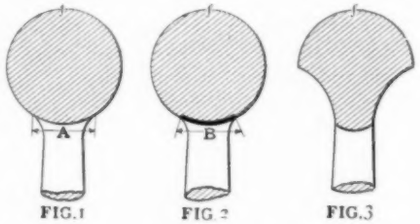


FIG. 1 FIG. 2 FIG. 3

RIMS OF HAND-WHEELS

course this was O. K. in the B. & S. foundry, but our foundry man learned his trade making sash weights and it was out of the question to ask him to work as fine as that. What we finally came to was the hand-wheel shown at Fig. 3, in which no attempt is made to preserve the circular section, and only the semi-circumference of the rim section is finished. The ball of the thumb and ends of the finger fall naturally into the groove, and moreover we are not wasting any finish.

Of course it is mean to tell on the man who designed this rim, but he did not tell on himself, and I, after being told to look, discovered it on the designer's machines. So that, although not the inventor, I may be called the discoverer, and that is no "worthless work" chestnut either. MICKY MCMACK.

Tempering Steel with Cyanide

At page 216 Mr. Ashley says: "I heat the cutter to a bright cherry, then smear it with cyanide and let it soak till its nose begins to run." Let Mr. Ashley take a piece of common bar iron or machinery steel and treat it with cyanide the same as he does Novo steel (he can cool it off in water if he likes) and he will find that there is no difference whatever in it; it is as soft as though it had never been touched.

EFFECT OF SOAKING

The very fact of his soaking it has burned the cyanide out, but still he has gone a long way toward shortening the life of whatever tool steel he puts cyanide on when he hardens it this way.

"Common Sense," at page 352, has put matters in a very bright light, and I can but indorse his opinion that the existence of cyanide should be forgotten whenever tool steel is to be hardened. As regards water for hardening, soft water should be used without any ingredient whatever. Of course the ideal water for hardening is distilled, but this is very difficult to get in most shops.

HARDENING BUSHINGS

At page 639, Mr. Ashley, in explaining his method of hardening, states that he hardened the bush No. 2 as hard as he possibly could; from this I conclude he made it very hot before cooling off. I was always taught when an apprentice, and have found it true in practice, that if you make a ring of any description of tool steel too hot it contracts, if not hot enough it expands, but that if you give it the right heat it will come out the same size as you made it. Mr. Ashley will find that if he takes notice of the heat he will be able to harden every bush or die exactly right without applying cyanide as he is doing at present; but he will have to "cut and try," for there are so many different kinds of steel that a heat that will suit some brands will not be right for others.

EXPERIENCE IN HARDENING SMALL TOOLS

J. F. B. states at page 486 that one of the largest manufacturers of small tools in the country who has a world-wide reputation for good work uses cyanide on practically every article hardened. I will relate a little experience of my own. At one shop where I was employed I had a number of reamers to harden, of a tool steel ordered in by the new foreman as being "the goods." After a number of attempts I found I could not harden the tools without getting soft places that could be "bit" with a file. I told the charge hand the result, and he of course told the foreman. The orders came back, "Put some cyanide on." The last I saw of the reamers before they went to the grinding shop was when the foreman handed one to the proprietor of the works with a file, saying: "Try 'em, Mr. ———. Beautiful steel!"

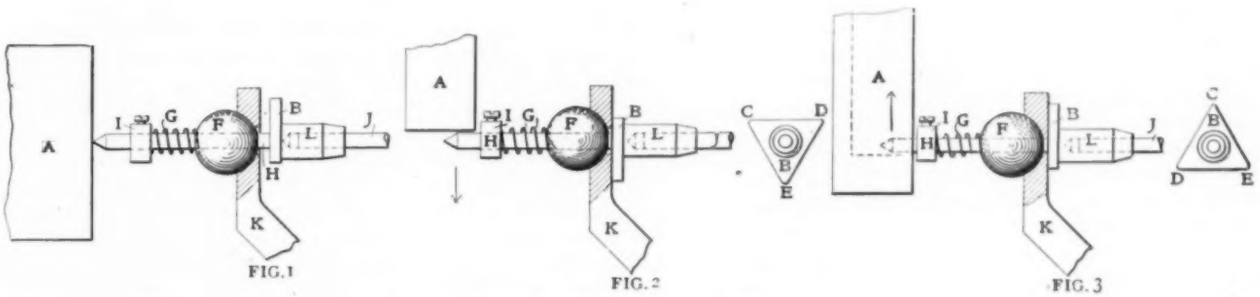
B——, England. MAC.

A Lathe Test Indicator

The illustrations show the indicator applied to various kinds of work. At Fig. 1 it is truing a piece of work *A*, having a center punch mark in which the center is located. Fig. 2 shows the tool applied to external work and Fig. 3 shows it applied to internal work.

The center rod *H* is a sliding fit in the ball *F*. At the one end of *H* is a piece *L* having a triangular flange *B*. Between *B* and *F* is the holder *K* which is held in the toolpost. A collar *I* abuts against a spring *G* which holds the ball *F* against *K* by spring pressure. A pointer *J* is inserted in the piece *L*; it may be of any length desired and its office is to multiply the amount of wabble of *H*. In Fig. 1 the center is pressed up against the work till the flange *B* is clear of *K*. As the work *A* is rotated the amount of its eccentricity is multiplied at the end of *J*. In Fig. 2 the side of the work farthest from the center strikes *H*, moves it in the direction of the arrow and the pointer *J* rocks back and forth on the edge *C D* of the triangular flange *B*. In Fig. 3 the same thing occurs except that in this case the pointer rocks on the edge *D E*, and the part of the work nearest the center strikes *H*.

ANOTHER CAMERON.



A LATHE TEST INDICATOR

Cannot Symbols Used in Formulas Be Standardized?—Old Kinks New to Some—Hand Books

I notice that at page 709 W. Osborne speaks of writers describing devices that have been known to the trade for thirty years. While this may be the case, nevertheless, such descriptions bring devices to the notice of many who would not otherwise hear of them, for we have not all of us been fortunate enough to learn our trade in a job shop, where a man is supposed to get out anything that comes along, whether he has tools to do the work or not.

REMOVING A STUD.

As a sample of an extremely simple idea that was apparently unknown by a shop foreman, I recall the following: We were fitting an attachment on a plain milling machine for doing a special job and wished to remove a stud from the side of the machine, and as it was threaded all the way up there was no chance to get hold of it with a pipe wrench without spoiling the thread. One of the men put a head on it by screwing on two nuts and jamming them together and easily removed the stud, but the foreman had never seen this done before, and he was a pretty good man and had filled his position satisfactorily for years.

THE USE OF HAND BOOKS

In regard to the use of hand books, I note that one writer states that they appear to be useful only to those who already know. I think this is only partly true, for while one must have enough knowledge to use what is in them, the great thing after that is to be familiar with the contents of the book and the index, so as to be able to find the tables and data that are most frequently used, with the least possible delay. The most important thing is to get a hand book that is suited to one's special needs.

BOOKS SUITED TO ONE PERSON NOT ADAPTED FOR ALL

I have four, but keep only one at the office, as I have found the other three to be of such little use to me as hardly to pay for the trouble of carrying them around. The one that I do use I have had for ten years and I can almost tell the pages on which the various tables that I use most are to be found.

I do not often have to refer to other books for information, yet I have heard others condemn this book very severely, though after a further acquaintance with them, I have found that they did not have enough acquaintance with the contents of the book to entitle them to pass judgment upon it.

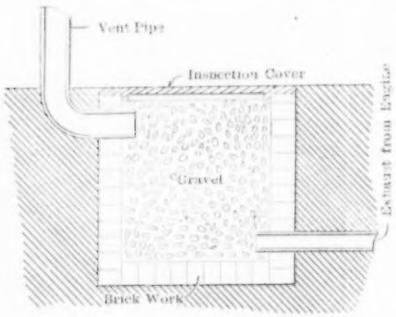
FORMULA SYMBOLS

Mr. Osborne's remarks in regard to the standardization of formulas and symbols are well timed and if the authors of technical works would only "get together" and do something along this line, some of us who have been out of the technical school a long time, and others who were never in it would get

better results in our attempts to use their formulas. W. ALTON.

Silencer for Gas Engines

I was interested in W. Osborne's article on "Noises," at page 567, and it prompts me to describe how we silence gas engines. The sketch makes it pretty clear. We erect quite a lot of engines, and in some cases it is necessary to put a muffle on the exhaust. The ordinary gravel box stuck on the end of the pipe takes only the sharp edge off the noise—acts as a sort of soft pedal. We used it for some years, but a job came along where an engine of 30-brake horse-power had to run on Sundays and occasionally all night. As it was located in a quiet residential neighborhood, it was essential that the engine cough should not be heard.



SILENCER FOR GAS ENGINES

We dug a hole about three feet each way and lined it with a single course of brick set in cement. The top of the pit was fitted with an inspection cover to facilitate cleaning. The pit was filled with clean pebbles about the size of a walnut and the exhaust pipe turned into it. In one corner a vent pipe was introduced and carried to a convenient hight. This pipe prevented the accumulation of any pressure, and also carried the smell out of reach.

It answers perfectly, and we have many times since adopted the same plan. The pebbles want removing about every six months, washing and replacing. Don't use anything but pebbles (broken bricks won't do), and don't let them be too small.

L——, England. JUNIOR BOSS.

Making Shot-gun Barrels in the United States 30 Years Ago

Thirty years ago all the iron that was worth anything for fine tools, guns, etc., came from Sweden, and was very expensive, so it is not to be wondered at that, we are told, the village blacksmith saved all the "Swedes" iron horseshoe nails which he drew from the feet of the steeds of that time. These nails were generally thrown in a corner until from 50 to 100 pounds had accumulated and then they were sold to anyone who cared to pay from three to four cents a pound for them.

The purchaser was ofttimes a manufacturer, in a small way, of shot-guns. He took the nails, or paid the blacksmith to do so, and after making a three- or four-inch ring of Swedes iron from a piece of the bar stock, filled this with the old nails standing on their heads. Two such rings full of nails were then placed one on the other, points together, and the whole thing put on the anvil. A few blows of the sledge hammer sufficed to make an almost solid mass. This was placed in the fire and brought to a welding heat and then hammered and heated again until there could be no doubt as to its being "one." Next it was drawn out into strips about one inch by ⅛ and any convenient length. These the gun maker welded around his mandril, producing the famous twist barrels so common in Europe. W. L. McL.

Starting a Shop

After reading the articles by Entropy, Dixie and others, I thought perhaps my experience in starting my shop would be of interest. I have always read with much interest all articles that applied to small shops, because my shop is small, and naturally I would be more interested in the small shop. I would like to hear from others who have a small shop and who started, so to speak, with nothing.

My start occurred about twelve years ago when I was 18, and living on a farm. I first started in with electricity, the same as a great many boys are doing today. I kept this work up a short time, all the time I could get when I did not have to work on the farm, and that was not much, as I preferred to work in the little shop than out in the field.

I made up my mind I must have a lathe, so I begged my grandfather for one. He bought me a No. 5½ Barnes foot-power lathe. When it came, in five boxes, my grandfather bet me a dollar I could not put it together, but lost his bet as I soon had it assembled and a piece of iron in, doing my first lathe work.

There being no shop in town, I soon had a number of customers come to me to get work done. I picked up quite a few dollars, which I spent for small tools. I soon bought a set of 2 horse-power upright steam-engine castings, which I finished with the exception of boring the cylinder and turning the fly-wheel and crank-shaft. It was not long before I had to have a boiler, so I went to work and built a small porcupine type of boiler.

Things ran along in this way for a little over a year. Then I wanted to move to town and start a machine shop. So I had to ask my grandfather again for a little help to get started, as I had spent what little money I had made for small tools and castings, etc., for the boiler and engine. My grandfather rented a small piece of ground near the grist mill and put up a small building 18x24 feet, bought a 21-inch Snyder drill press, a piece of shafting, a few pulleys and what belting was needed. This was my shop as started in July, 1896.

I took steam from the mill boiler and did not use my boiler except when they were not fired up. In about a year I bought a 22x22x5-foot planer. I had previously bought castings for a small emery wheel, on which to do saw gumming and other grinding, which I finished up myself. I also bought a 10-horse-power upright boiler and steam pump.

Business was good. I had one man working with me, but got crowded for room, so in the spring of 1898 I started work on a larger shop. I bought a lot and put up a two story brick building 28x50 feet with three rooms: machine room, boiler room and blacksmith shop. I also bought a 24-inch New Haven lathe, a large emery grinder and a power saw. Such is my shop at the present time.

Two years ago I took up the manufacture of gasolene engines to fill in my spare time. I am situated in a good farming country, with no competition, the nearest shop being ten miles distant.

In regard to money matters I have had no trouble to speak of in getting money due me and have not lost over $15, which I think is doing well. I have not over $75 book accounts that I cannot get any time I go for them. While this $75 is not really *good*, I have not given up hopes of getting it.

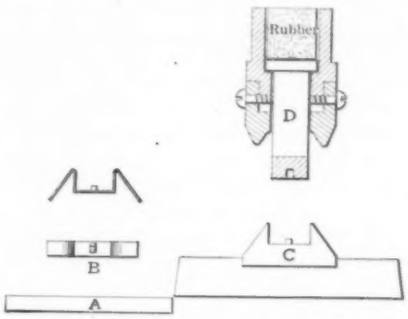
Dixie's method of "50 per cent. deposit required on all work" is a good thing, but I do not think I could ask it here with success, as a large amount of work is brought in by the hired men, who are not able to pay or who do not generally have any money with them and would have to go out and borrow it, in order to pay the 50 per cent. deposit. To those not known or customers who are slow pay, I require cash when work goes out.

I heartily agree with Dixie about buying a small steam engine and boiler. They are more bother than they are worth, for a good gasolene engine is much better and takes much less looking after. It is started in a minute and all expense stops when the engine is stopped. In a small shop the engine is not needed all the time, but where steam is used, steam has to be kept up just the same. I use steam in the winter and a gasolene engine in summer when no heat is required.

I buy for cash only, and always take advantage of a 2 per cent. discount in 10 days where possible to do so, and pay all bills when due. H. C. DAVENPORT.

A Punch and Die

The illustrations show a punch and die for forming up clips which are made from scrap from another job. *A* shows the



THE WORK, THE PUNCH AND THE DIE

blank and *B* the finished clip which is made at one stroke. *C* is the die and *D* the punch which is shown in section.

HARRY E. STRUNK.

High-speed Steel—Some Experiences in Annealing, Machining and Hardening

I wish to relate my experience of a year with high-speed steel. During the time, we have used seven brands, which seem to work about alike. When we bought the first lot our trouble started at once.

AN ATTEMPT AT ANNEALING

We first attempted to anneal the steel by putting the pieces in heavy tin buckets and covering with lime, then placing the buckets in an iron box, and covering them also with lime; here they remained for at least two days. When we tried the steel to see what it was like, we found it to be as hard as when we put it in; and it was impossible to plane it. We then tried this method of "annealing" the second time, but found very little improvement. However, we tried to work it, hard or soft, and ruined tools, planing it up, running slow speed and taking fine cuts. It took longer to plane one set of cutters, at this time, than it does now to plane five sets.

FURTHER ANNEALING EXPERIENCE

The next lot of steel we threw into a regular coal furnace, and got it to a good heat, leaving the work to cool off with the furnace, and allowing no air to get into the latter. When we took the steel out, we found it could be worked without any trouble. When we wanted to anneal some more of the same steel, the furnace we had used was being used for other purposes, so we went back to our first method, only instead of using lime, we put soft-coal ashes in the buckets, and then put them into lime boxes, allowing no lime to get into the buckets. We left the steel in three days and three nights, and found it worked successfully. Afterward we again tried soft-coal ashes and lime boxes and found we could not do a thing with the steel.

HOME-MADE GAS FURNACE

Finally we came to the conclusion that we would make an ordinary gas furnace, to be used for annealing only. This furnace was made of brick lining with a crucible inside, and we do all our annealing in it at present. However, we have trouble every now and then, and sometimes are obliged to re-anneal the stock, leaving it in the furnace for at least three days.

BORING AND TAPPING

After the annealing is over, we take the parts (die blanks) to the vise hands, who fit them into frames, ready to be bored. This operation is performed without trouble (running slow speed) and the pieces are then ready to be tapped. Now the trouble starts with the tapping. We set the first die into a block, and the first tap was put in; running down about five threads, we found the tap was no good. The next tap that we put in, we found, could tap about three more threads, and that little work rubbed off the threads of the tap. After putting the third tap in we found the same trouble, but made up our minds to finish if we ruined taps, dies and everything. After running the fourth tap to no advantage, we found that the fifth one finished the job, making the finest threads that one could put into a die.

FINISHING AND HARDENING

When we took the die apart everything went smoothly, until we put the cutting edges on. Then the shaper hands had all kinds of trouble. At last we got the cutting edge on; then the vise hands filed this edge, and ruined five files. For hardening we heated the work to a good *white heat*, threw it into coal oil and then drew the temper to a straw-color.

Here we put the dies into the machines, increasing the machine speed from 48 to 74 revolutions per minute. The dies worked for three days and three nights without grinding. Then we examined them and found that the threads were burned flat. We also found the cutters were not hard enough and the speed not high enough.

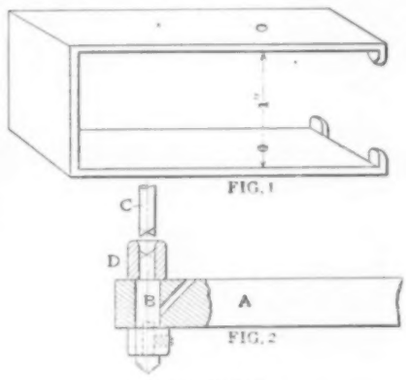
OTHER METHODS OF HARDENING

We took the same set, retapping them to overcome the burned threads, and hardening them by bringing to a white heat in the blacksmith fire and throwing them into fish oil. Here we found the temper was all right. Nevertheless we resorted to other ways of hardening: that is, we tried borax in the threads to keep them from cracking and breaking. But we found trouble in getting the borax out, so we stopped that, and went back to the old way, dipping in fish oil, and not drawing the temper. Then we started, speeding the pipe machines to 84 revolutions per minute, that is for one-inch pipe. The difficulty was then with the lubricant, for on high-speed dies there must be a sufficient amount of oil, in fact about four times as much as on ordinary dies: for as soon as the die gets warm it picks up iron on the cutting edge, causing delays on the machines. While we have found that the different steels we use work about the same, there are some that are more apt to break than others; and the threads in dies of certain steels turn over more readily than if other brands are used.

S. I. W.

A Novel Burring Tool

The difficulty of removing the bur from the holes on the inside of the bent iron piece shown at Fig. 1 caused me to devise and make the tool herewith described. This difficulty will be apparent when it is noticed that the distance between the sides of Fig. 1 is only one inch; therefore the length of the spindle and countersink *B*, Fig. 2, must not exceed one inch. The spindle carrying the countersink runs in a bearing in one end of a ⅜-inch steel bar, the other end of the bar having a wooden handle (not shown). The spindle *B* is kept in its bearing by the tight collar *D*, the internal edge of which is rounded off for easy insertion of the driver *C*. This driver is made of drill rod, an easy fit for the ⅛-inch holes in Fig. 1, the end of it being shaped to form a clutch in conjunction with the end of the spindle *B*, which is shaped exactly the same. To operate the tool, the driver is fixed up and run in a lathe by preference, as the horizontal position is preferable to a vertical one. The



A BURRING TOOL

tool, held by the left hand, is put between the sides of Fig. 1 with the axis of the spindle in the axis of the two holes. The tool and piece are then fed onto the driver until the teeth of the driver and spindle engage, the countersink thereby being rotated while the piece is pressed against it. To do the opposite hole the piece is withdrawn and reversed. The wearing parts should be hardened and the clutch teeth should be tempered to prevent chipping.

W. MADDISON.

London.

Some Features of the N. P. Pratt Laboratory

BY F. W. FEIKER

The new machine shops of the N. P. Pratt Laboratory, of Atlanta, Ga., are an excellent illustration of the adaptation of the electric motor to machine-tool work. The N. P. Pratt Company is an engineering and contracting company, making a specialty of equipment for fertilizer factories, sulphuric acid plants, brickyards, quarries, mines, etc. Until recently this company has operated a factory in Atlanta, but the increasing business prompted the mangement to erect an entirely new plant at Kirkwood, about four miles from that city, the site chosen being located on the suburban lines of the Georgia Railroad, and conveniently reached as well by the city car lines.

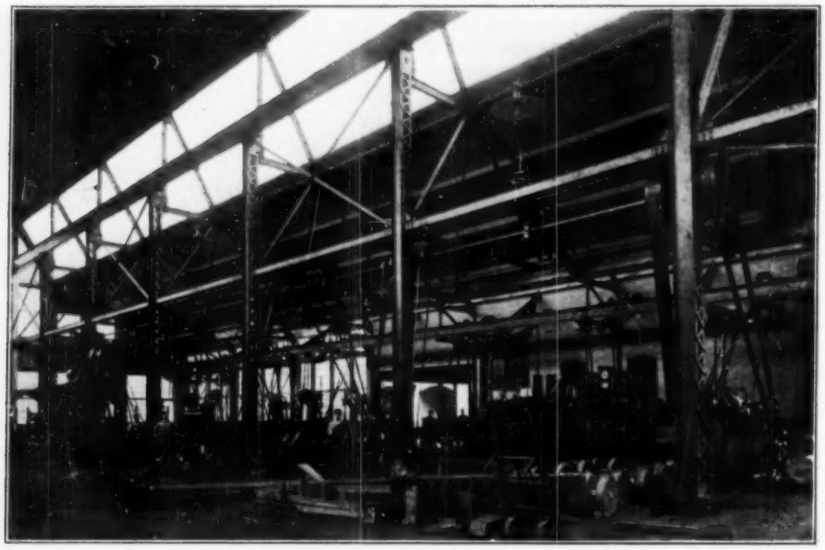


FIG. 1. INCLINED MONITOR WINDOWS

THE LIGHTING

The natural and artificial lighting has received careful study, and it will be noted from the illustrations that, in addition to the large and numerous windows, special provision is made for overhead lighting. At the point where the main bay drops to the side bay, skylights are provided, set at an angle of about 30 degrees with the wall, as shown in Fig. 1. It is customary to place these skylights vertically, but the new method prevents shadows between the main and side bays, and tends to give a better diffusion of light. The skylights are arranged in two sections, the upper portion being stationary, while the lower part swings from the upper side for ventilating purposes. Ventilators are also placed in the roofs over the main bays. The foundry and machine shop are practically duplicates, the only difference being that the foundry is arranged to include a cupola room.

In the engine room two General Electric direct-current generators are installed, each having a capacity of 50 kilowatts at 250 volts, when running at 280 revolutions per minute. The generators are direct connected to Harrisburg side-crank engines.

DISTRIBUTING THE CURRENT

From the power-house the power cables are laid in ducts to the main buildings. These ducts are of concrete, 36 inches wide and 42 inches high, and carry the steam and air pipes as well as the electric cables. Provision has been made for ventilating the ducts by chimneys, which pass up through the front wall of the machine shop, and even on the hottest summer days no trouble has been experienced by overheated air in the conduits.

The main conduits pass under the floor of the machine shop, there dividing into two branches running the length of the building, each of the same cross-sectional dimensions as the parent trunk. Air, steam, and electric connections are made from these. The method of wiring the various motors from the ducts is a feature of special interest. The ducts are located about the middle of the side bays, as this is the most accessible place from which to wire the motors located in the bays. The floor of the machine shop consists of a 4-inch bed of concrete on a solid clay foundation, and above this 2x4-inch pine blocks, sawed 4 inches long, are set on end. The blocks are laid in a coal-tar mixture, and the cracks are filled with the same preparation. All of the heavier machines, of course, have their special foundations, but the light machines are placed on the floor and anchored down by expansion bolts. In order to wire to a motor, all that is necessary is to remove a row of the pine blocks leading from the motor to the nearest duct, and drill a hole through the roof of the duct. The conduit is then laid from the opening in the duct to the motor along the trench made by removing the pine blocks. The blocks removed are next deeply grooved by sawing out a V-shaped section, and laid over the conduit in their original position. This method has proven very satisfactory, not only making a neat job but enabling the machines to be located conveniently without special attention to the position of the conduits. Cut-ins are located at convenient points about the shops, so that portable tools and lights can be quickly connected.

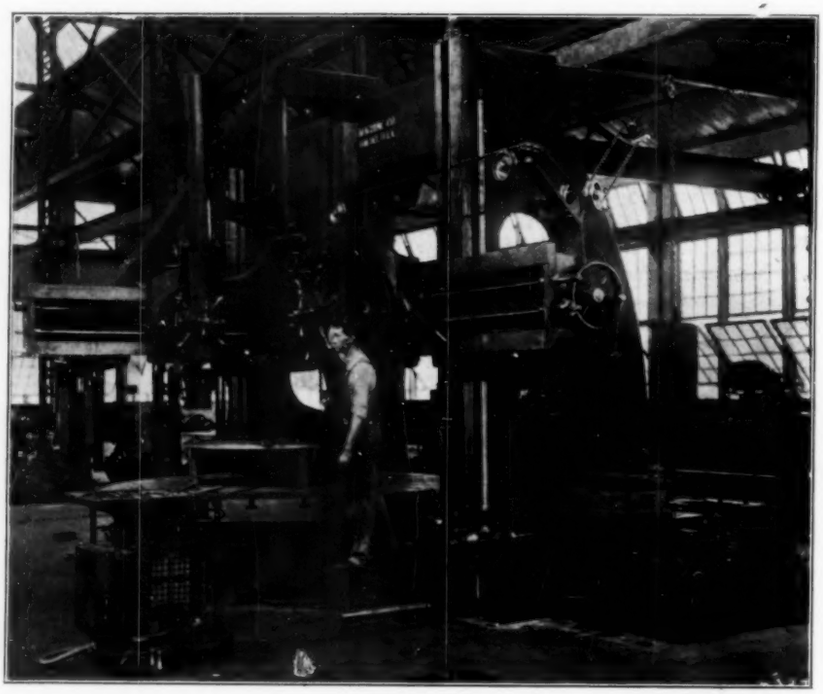


FIG. 2. ELECTRICALLY DRIVEN BORING MILL SHOWING PORTABLE CONTROLLER

The accompanying illustrations bring out the advantages of the electric drive at

the machine tool. The electrical equipment throughout the plant is of the General Electric manufacture. There are installed in the shops 29 stationary motors of both variable and constant speed, aggregating a total of 202¾ horse-power. The constant-speed motors are of their CQ type, and the variable-speed motors are of their CR type.

FEATURES OF THE TOOL DRIVE

The main bay of the machine shop is devoted to erection and portable tool units. The largest machine tool in the plant is a 16-foot Betts boring mill, operated by a 15-horse-power 400/1200 revolutions per minute variable-speed motor. The rails of this machine are driven by a 5-horse-power 1100 revolutions per minute series-wound motor controlled by a full reverse type of controller. The 15-horse-power driving motor is governed by a similar controller, Fig 2, mounted on a portable stand, so that it can be placed at any convenient point about the boring mill.

The method of adapting the motors to the lathes is shown in Fig. 3. The lathe motors throughout the shop are mounted on the head stock. The illustration shows also the method of control. The controller is mounted on the tail-stock end of the lathe, and is turned from the apron by a short lever operating through an intermediate rod with sprockets and chain. In some of the lathes the controller is mounted behind the head stock, with the controller handle at the lathe apron.

Machine.	Type of Motor.	Voltage.	H.P.	R. P. M.
Group (line shaft)	CQ Constant speed direct current	220	20	900
Group (line shaft)	CQ Constant speed direct current	220	5	1600
52-inch Gisholt Boring Mill	CR Variable speed direct current	220	10	800 to 1500
10 16 Betts Boring Mill	CR Variable speed direct current	220	15	400 to 1200
Rails f r above	CR Wound as series motor	220	5	1000
Rumblers	CQ Constant speed direct current	220	5	1600
Emory Grinder	CQ Constant speed direct current	220	1½	1060
Milling Machine No. 4	CR Variable speed direct current	220	5	800 to 1500
Key Seat Milling Machine No. 5	CR Variable speed direct current	220	3	500 to 1000
Group Drive	CQ Constant speed direct current	220	20	900
Fosdick 5-foot Radial Drill	CR Variable speed direct current	220	3	800 to 1500
Fosdick 2-foot Radial Drill	CR Variable speed direct current	220	2	800 to 1500
Schumacher & Boye 30-inch Engine Lathes	CR Variable speed direct current	220	10	400 to 1600
Detrick & Harvey 60-inch Planer	CQ Constant speed direct current	220	20	900
Oliver 38-inch Band Saw	CQ Constant speed direct current	220	5	1600
Oliver Universal Saw Bench	CQ Constant speed direct current	220	5	1600
Oliver 38-inch Paper Makers' Lathe	CR Variable speed direct current	220	5	800 to 1500
Whitney Single Surfacer	CQ Constant speed direct current	220	7½	1500
Core Machine	CQ Constant speed direct current	220	1	1240
LeBlond 20-inch High Speed Lathe	CR Variable speed direct current	220	5	800 to 1500
Blower Belt Heater	CQ Constant speed direct current	220	15	975
Cut-off and Band Saw	CQ Constant speed direct current	220	5	1600

SCHEDULE OF ELECTRICALLY DRIVEN MACHINE TOOLS.

The table gives a list of the motors and the tools which they drive.

At the annual meeting of the Engineers' Society of Pennsylvania, S. M. Kintner was elected president, Geo. T. Barnsley, vice-president, A. E. Frost, treasurer, and Edmund Yardley, secretary. R. A. Cummings and Walter Riddle were elected directors for two years and F. Z. Schellenberg and J. O. Handy directors for three years.

FIG. 3. LATHE DRIVE SHOWING CONTROL FROM APRON.

The Boston Educational Congress

BY ENTROPY

Boston is the city where the sidewalks are so narrow that the natives walk in the streets, after the fashion set by the historic cows who laid out the town in Colonial days. Boston is likewise the center of learning, for those whose minds so see it, and also the site of Tremont Temple. What more natural, then, than that Boston, being the seat of learning, the site of a desirable hall, and generous in giving the use of what sidewalks it may have to strangers, should choose itself a meeting-place for a congress, an educational congress, and above all, since Tremont Temple is but a step from Beacon street, a social education congress?

The call for the meeting tells us that "The complexities of modern life and society demand, however, that our youth receive a systematic training for their duties in those civic and social groups in which they are to do their work in life." This, I am told, translated from Back Bay into the American language, means that if a boy must hustle for a living, he should be taught systematically to hustle, rather than merely be fitted with Back Bay education, and then dropped into life to sink or swim, as his natural instincts guide him.

Since for the past year or two I have been firing occasional charges of bird shot at the machine-shop branch of "social education," otherwise known as apprentice education, it interested me greatly to attend this congress, and see for myself the big guns in action, to see if they were trained low enough to touch the subject at all, or if they shot over it.

Someone may ask what qualifications I may have to judge whether their shot hit or not, since I admit belonging to the

bird-shot division. I have been all around this subject. I have worked at the bench, lathe, and planer, with the men and the boys these people wish to reach; I have hired these same men and boys and had them work for me; I have been to school and acquired the Back Bay education, and I have taught school, though never the Back Bay brand. I have gone hungry, footsore, and faint, as they do, and I have traveled and hotelled Back Bay style. I have therefore been on all three sides, workman's, manufacturer's, and educator's.

THE PEOPLE INTERESTED

What manner of people show interest in this industrial branch of education? I confess that I was disappointed; not but that the heavy artillery came up to my expectation, but the audiences—nine out of ten men, from my point of vantage in the balcony, showed me either white hair or such an arid desert as to make it indeterminate as to whether they parted their hair in the middle or on one side. The feminine element, since this was an educational congress, and in Boston, was large (comprising at least 50 per cent.), and, it goes without saying, young and fair to look upon. Where were the young men? I don't know. I was lonesome, having still a full allowance of hair on my head, and but few gray hairs—too few for the company. "Old men for counsel, young men for war." Here we may have counsel enough, but the war?

THE SPEAKERS

On the platform it was better, and yet it seemed doubtful to me, as I scanned these men, whether any of them had felt in his own person the limitations of the latter-day lack of shop training. Of the speakers, two have done something, and to them we listened with the attention that belongs only to the speaker who recounts his or her personal experience. These were Mr. Alexander, of Lynn, and Mrs. Woolsman, of New York, and no one could listen to these two speakers and not feel that they were in the fight and making a good fight, too. At the morning section Mr. Alexander went over the story of the Lynn school with which your readers are familiar. Possibly, proximity to Beacon street may have made his address seem more of an argument as to why his school ought to succeed, rather than an account of the school and the difficulties met and conquered. A criticism was later offered, one which seemed to me hardly valid, that Mr. Alexander was educating, not all-around men, but specialists for the particular work of the General Electric Company. This was fairly met later, as I will point out.

ATTITUDE OF ORGANIZED LABOR

At the morning session, too, there appeared representatives of organized labor. Their presence and their remarks met evident approval. They believe, as Professor Richards, I think it was, well put it, in the right kind of a trade school, but were not prepared to state what they would consider the right kind, in which respect they were not one whit worse off than most of the other speakers. But one point they hold to, and that is that the right kind of a trade school will of necessity be conducted by the State. State control is their slogan. Whether this is dodging the question, since State control can only be effected through a vote of the citizens (the majority of whom are wage-earners) so that in reality they are only saying that they advocate trade schools, provided they do advocate them, I hardly know. This I do believe: that workingmen and their representatives if met fairly and frankly on this question will respond more favorably than many people are ready to grant, and this I believed before I had the satisfaction of hearing these men say it.

In any case we have to remember that these speakers were leaders, and therefore necessarily ahead of the rank and file, from which it is also evident that the rank and file may be expected to follow somewhat tardily the counsel here given. For this one reason, but for no other that was advanced at these meetings, I should say that the consensus of opinion fell rather to the side of State control. The chairman of the State Commission for Industrial Education reported the progress which that commission has made in obtaining permissive legislation on the trade-school subject, which it hopes to follow up by positive recommendations at least, if not by legislation.

THE HIGHER THOUGHT

So much for the 6-inch and 8-inch guns; now for the 10s and 12s of the evening. Here is where the test must come. The morning session certainly was well within the bounds of ordinary comprehension. It dealt with the trade school as an established fact, and as one which must spread. It dealt with the attitude of workman and master and educator toward a concrete thing. Now for the higher thought, the heavy firing.

Around Massachusetts bay there dwells a people, numerous and proud, a self-appointed aristocracy. If anything is done it must be done by one of these chosen people; otherwise, it were not worth the doing. These are the people famed far and near as the descendants from the "Mayflower." And yet the first speaker of the evening was a man recognized as one who has done things worth while, although the name of Fish does not appear on the register of the "Mayflower." But with the tolerance of things of New York that has of recent years softened the edges of the "Mayflower" cloud, it may have been found that the name of Fish is older on this continent even than that of the "Mayflower." I recall that there was one Preserved Fish, so called because he was picked up floating in a barrel in the harbor of New Amsterdam. However, whether this is a sufficient excuse or not, Mr. Fish seems to be accepted by Beacon street and Back Bay, and he seems to have done things worth doing. One of these things was the preparation of his address.

THE DUTY OF THE STATE

Mr. Fish's feeling seems to be that, since the State has dictatorially taken to itself the command of the best part of the time of both boy and girl for eight years, and the eight years at which they are most susceptible to the taking up of new ideas, therefore the responsibility of the State should include responsibility for the introduction of these boys and girls to a greater or less degree, to those vocations at which they expect to earn a livelihood; that is, that their education should be vocational as well as literary; that a boy is none the less educated because he can read less Greek and do more carpentering.

Boys and girls of years ago could see work done, as in a blacksmith shop they could watch the whole process of making shoes and nails, whereas today there is no such opportunity, since such work is factory work, and is so subdivided that few men understand all the processes involved. Again, the time taken by the State deprives a carpenter's boy of the chance to pick up the use of his father's tools since his day is so occupied. So when boys are ready to leave school at 14 years of age, they drift, simply drift, picking up a little knowledge here and a little there, often finding the easy road the down-hill one, and all because the State is not making a fit use of the child's time which it arbitrarily demands. His recommendations for such schools, however, to my mind showed him to be in the state where so many men are today—seeing an evil, anxious to point it out, and to right it, but missing the point of view of either of the parties to the question. His appears to be the point of view which has led to the several third- or fourth-rate technical schools of the country, all of which were founded to teach trades, and which still have that fundamental idea dimly in view.

EXPERIENCE OF A GIRLS' TRADE SCHOOL

The next speaker, Mrs. Woolsman of the Manhattan Trade School for Girls, said more that may be of interest and value to the readers of the AMERICAN MACHINIST than any of the other speakers, paradoxical as it may seem. Mrs. Woolsman has the look of a person who is in the habit of doing things; not the New England school-marm look which makes you feel that its owner can make others do things, but the look of downright ability to do, that carries others along by leading rather than by forcing.

She spoke of the things which had come up and are coming up daily in the affairs of her school; the things which must be promptly met without a precedent for a guide; the difficulties in meeting the needs

of pupils and manufacturers, and the difficulties in getting a teaching force; the real, live difficulties which her school and which any school must meet. She deplored the inefficiency of the education of the schools—the literary education—and its inapplicability to the work of the girls. She believes in culture, but she holds that culture is what makes one grow in dexterity as well as mentally. To meet the needs of manufacturers and pupils, the trade which around these parts is called that of seamstress is divided into forty or fifty trades, distinct but depending upon each other. These trades are taught, not by forewomen from the shops who only drive, nor by professional teachers who only seek to teach, but by university women who have gone into the shops as workers and learned to do the work as it is wanted, and who teach it as it is wanted by the manufacturer.

Here I revert to Mr. Alexander and his address of the morning. Mr. Alexander may be teaching men to do the work which the General Electric Company wants, and in the way they want it done; but in order that a school under State control may furnish the General Electric Company with satisfactory men it must do the same thing. The school must study the demand or it fails of its purpose. Fortunately the demands of different manufacturers probably will not be essentially different.

Mrs. Woolsman stated the difference between a trade school and a technical school more aptly than I ever heard it stated before. A technical school reasons things out, it goes ahead by leaps and produces a swelled head. A trade school must take every step, no matter how insignificant, and do it thoroughly. In the school room, both this speaker and Mr. Alexander have found it necessary to create a new arithmetic and other studies, bringing home to the boys and girls by examples what the studies are good for in the particular trades followed. She has found a most beneficial influence in the growing self respect of the children, due to the responsibility for neatness and care, and this in turn has enabled the school to furnish to the manufacturers girls who command good pay—high pay compared with what many male counter-jumpers earn—because of their dexterity and reliability.

A SCOFFER AT SKILLED LABOR

And then came Mr. Vanderlip, the apostle of German education and the National City Bank, the man on whose spoken word the stock market goes up or down, the spokesman for Wall street. Mr. Vanderlip is surprised at America's prosperity. I do not know but that it grieves him. He finds excuse for it in the native ingenuity and the National Genius for Organization, spelled with gilt capital letters and respectfully dedicated to the National City Bank. He finds that skilled labor has no place in national progress. Rumor says that Mr. Vanderlip once worked at the machinist's trade, but that when there was a chance of his becoming sufficiently skilled to help the national progress he forsook it for other fields.

So it is possible that his point of view is clouded; perhaps he forgot that others do go further into the trade than he did. Some one—was it Emerson?—said that if you made anything better than your neighbor the world would beat a path to your door. I myself have found it so. I once built machinery, not so well but that I can point to a great deal better "made in the U. S. A." but well enough so that, insignificant as my business was, every prominent tool dealer of England and Europe came to my shop to see it and to buy it; not because of price (unless they are all liars, which I doubt), and not because of prompt delivery, but, if their words are true, on account of design and workmanship. These both mean skilled labor. A hundred such instances may be found. These shops will tell you that they are making their own men. They would like to be relieved of the burden by State or private schools, but they will see to it that this country keeps her place till long after Mr. Vanderlip has ceased to view this state of things with dismay.

German education he considers to have put that country at the head of the world, forgetting that Germany is confronted today with the fact that it has a tremendous oversupply of educated men who have nothing to do.

After all, what has come of these meetings? No one knows, but these people have spoken before audiences vastly larger than the number present would show, through the daily press. These particular addresses were somewhat overshadowed perhaps by some of the other branches of work which the congress undertook, but, all in all, it has been shown that trade education is wanted by manufacturers and men, and that it is possible to train teachers to carry on the work.

Legal Notes

BY E. P. BUFFET

REPRESENTATIONS AS TO WEIGHT OF CASTINGS

A certain company was engaged in the manufacture of heating furnaces, and having no foundry of its own, it bought its castings outside. After having obtained them at one place for several years, it made a five years' contract with another foundry company to furnish them. The agreement set a price per pound depending on the current cost of iron, the weight of the castings to be calculated from the "pattern weight" (the patterns being castings themselves) by adding 6 per cent. to one class and 8 per cent. to another. The foundry company claims that the real excess above pattern weight turned out to run as high as 15 per cent., and above, and, therefore, more expensive to itself. It contended for a right to break off the contract and sued for damages, alleging that it had been induced to enter the contract through knowing misrepresentation by the furnace company as to the fairness of the allowance, based on facts exclusively in the latter's possession. On conflicting evidence the foundry company recovered a verdict in a Federal court, judgment on which was sustained by the U. S. Circuit Court for the western district of Pennsylvania.

The case went up to the Circuit Court of Appeals, which discussed the distinction between a false statement concerning past or present facts and one that is a mere promise or expression of opinion. The latter class is not generally actionable on the ground of false representation in an action for deceit (warranties, etc., being, of course, another question). The appeal court does not feel justified in reversing the decision here because of the jury's having been permitted to find this matter a valid cause of action. What the furnace company is alleged to have said seems to be regarded as capable of treatment as a representation about an existing fact, if so intended. The court, however, has ordered a new trial on another ground; viz., that the evidence on which the damages were assessed was indefinite as to their amount.
145 Fed. Rep., 596.

LOOSE BELT LACING

A tannery workman sued to recover damages for loss of his thumb while oiling a blower in operation, testifying that it was caused by his being struck by a loose piece of belt lacing. The jury gave him a verdict, but the Supreme Court of New Hampshire has set it aside on the ground that negligence on the employer's part is not shown. The court takes the view that the lacing must have pulled out at the time being, else before he put his hand through the belt it would have attracted his attention, as he said it did not do. Therefore the employers could not have known of its being loose; and since it is not shown that the injury resulted from any unsuitable material or workmanship or failure in legal duty to anticipate, inspect, etc., they are not liable. The blower had been installed only a few days.
64 Atl. Rep., 723.

WHAT IS A BUILDING?

The city of Concord, N. H., passed an ordinance that no person should use any engine in any building in the fire precinct without the written consent of the city engineer and the chief of the fire department. A practical case has put it up to the Supreme Court of the State to determine whether a partially inclosed wood-shed is a "building" within the meaning of the ordinance, and an affirmative decision has been handed down.
64 Atl. Rep., 725.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1906 *the* AMERICAN MACHINIST *printed and circulated* 1,083,205 *copies, an average of* 20,832 *per issue. Of this issue* 19,500 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Flying Machine on the Horizon

According to a recent press cablegram from Paris, those who have given most attention to the matter feel very confident that we are near an entirely practicable flying machine, and that it will soon be possible for us to claim "human mastery over the air." As usual, a good many wild prophecies are being made with regard to the effect of the use of the coming flying machine; but, making all due allowance for these, it still remains true, probably, that we shall see great advances in the art of aërial navigation within a few years. Captain Ferber, of the French army, who has been devoting all his time recently to this subject, asserts that success with flying machines has been virtually achieved, and that his government is preparing as rapidly as possible for the changes which it is foreseen will be the result of the use of such a machine, particularly with respect to military operations.

Of course it is quite natural that military men should consider first, if not solely, the effect of the coming flying machine upon military operations; but it seems to us that its effect upon other things may be much more profound and far-reaching. If the predictions made for the machine come anywhere near being realized, it will completely revolutionize the manner of life of many, if not most, people. The transportation problem, especially that which concerns itself with the getting of people into cities like New York in the morning, and getting them out at night, may be entirely changed. The good-roads problem may be largely eliminated and smuggling greatly facilitated. Of course we feel by no means sure that all the predictions made for the machine will be realized. We are only trying to imagine something of the effect that would ensue from the full realization of all the predictions made. In the meantime, it may be that the emphasis which is to be placed on the Aero Exhibition at Jamestown will be productive of practical results. We understand that the exhibit in that department has been placed in the hands of specialists in this line of work, at the head of which is Dr. Alexander Graham Bell, and that it is expected that the art and science of mechanical flight will be fully exhibited, illustrated and exemplified.

Proposed Investigation of a Trust

According to a press dispatch, the Senate has agreed to a resolution, directing the Department of Commerce and Labor to make an investigation of what is known as the "Harvester Trust." We presume this is done in the supposed interest of the farmers, and in the expectation that it will have a favorable effect upon their votes. We do not believe, however, that it is the best thing that the Department of Commerce and Labor could be doing. While it is true that the International Harvester Company owns a number of manufacturing establishments which were formerly separate and competing, it owns by no means all of them, and there is nothing so far as we are aware that prevents anyone from going into the harvesting-machine business. In other words the present companies must carry on their business in the face of actual competition, and also with a realization of potential competition; that is to say, competition which will surely be brought into the field unless their customers are treated fairly, and the business conducted so as to make only fair profits. So long as this is the case, it seems to us that the Department of Commerce and Labor might much better spend time and money making investigations of real monopolies; that is, companies or lines of business with which, or in which, there is no such thing as free and open competition.

The Weak Crust of the Earth

At the recent meeting of the American Association for the Advancement of Science in New York, John F. Hayford, of the United States Coast and Geodetic Survey, read a paper giving an account of some recent work in that department, by means of which the form of the earth is being determined. In the paper itself and by discussion brought out by it, it was made clear that the author of the paper regards the crust of the earth as being in a state of balance comparable to that of floating ice upon the surface of water. That is to say, he believes that the Rocky mountains maintain their altitude simply because there is under them a lighter or thinner portion of the earth's crust, which is buoyed up by the adjacent and surrounding heavier portions, and he declares specifically that North America, with the contiguous territory, is so sustained by the heavier and therefore depressed ocean beds surrounding it.

Mr. Hayford also spoke of the effect of the earthquake in California upon the triangulation work of the Coast and Geodetic Survey, and said that this survey required repairs which were now being made. He said that it had been shown already that in some cases the solid rock had been moved as much as 15 feet.

Mark Twain, we believe, ascribes the origin of his plan for perpetuating or at least very much extending the copyright upon his books to a previously carried-out plan of a similar nature by Sir Walter Scott. The plan consists in introducing new matter to be published with other material on which the copyright has expired, and we are wondering if Mark himself knows how much of this idea he may have derived from his experience with the construction of new machines, especially typesetting machines, in Hartford.

The Steam Turbine in the Navy —Probably the Most Important Problem in the Bureau of Steam Engineering

In his annual report Rear-Admiral C. W. Rae, Chief of the Bureau of Steam Engineering, United States Navy, has the following to say with reference to the use of the marine steam turbine in the navy:

"The rapid progress of the steam turbine elsewhere, and its increasing application to marine propelling purposes, particularly by other countries (it being stated that the British Government has decided to install the turbine in all future war vessels), points to this as probably the most important engineering problem of the present day. It is a radical change, however, involving many new features, and the bureau has pursued a conservative course in connection with the turbine, preferring to wait before adopting it extensively until it had been demonstrated as unquestionably the best system of propulsion for naval purposes. At the same time tests and inspections have been made whenever the opportunity offered, and extensive investigations of the question have been carried on. It is believed that when the three scout cruisers now building (two with turbines and one with reciprocating engines) are completed, and their trials have been held, comparative data of the utmost value will be obtained. As stated above, a 50-foot steam launch, to be fitted with turbine machinery, is building at the Portsmouth, N. H., navy yard, for comparison with boats of the same size fitted with reciprocating engines. For the purpose of securing further data in regard to turbine machinery and its operation, a representative of this bureau, under orders from the department, visited a number of plants where turbines are manufactured, and others where they are in daily operation. The results of this inspection, covering thoroughly the field of turbine construction in the United States, are embodied in a report to the bureau. An officer of this bureau is at present abroad making a thorough investigation of marine-turbine installations that are in operation and in contemplation."

Speaking of the experiment station at Annapolis, Md., Admiral Rae states:

"Pending the completion of this building, an experimental boiler has been installed in one of the old buildings of the Naval Academy, and the work of erecting the experimental marine-turbine engines, condensers, pumps, etc., is proceeding with the aid of skilled mechanics provided by the last appropriation bill.

"It is expected that the tests and experiments made with these turbines will afford considerable valuable data for the use of the bureau in connection with the designing of turbine installations for naval vessels. The operation of the turbines will afford useful practical instruction to midshipmen and mechanics prior to the detail of the latter to ships fitted with such machinery."

Personal

J. H. Smith announces that he has purchased the capital stock, property and good will of the Electrical Age Company, and that the paper will henceforth be published from 45 East Forty-second street, New York. Mr. Smith is president of the Electrical Age Company.

Edward F. Schnuck, who has for the past ten years been general superintendent of the factories of Arbuckle Bros., in Brooklyn, N. Y., is now a director in the firm of Jabez Burns & Sons, 542 Greenwich street, New York, builders of special machinery.

F. W. Broomell, a contributor to our columns, and who, for the past eight years has been general superintendent of the works of the Bagley & Sewell Company, Watertown, N. Y., has taken a similar position with Broomell, Schmidt & Steacy Company, York, Penn.

C. L. Libby, who was for some years superintendent of the machine shop of Ludwig Loewe & Co., of Berlin, and has more recently been chief engineer and designer of the Gisholt Machine Company, Madison, Wis., is now vice-president and superintendent of the International Machine Tool Company, of Indianapolis, Indiana.

Philip Fosdick, of Cincinnati, has again embarked in the machine-tool business and is vice-president of the newly formed Kern Machine Tool Company, of which Clifford F. Kern is president. This company will take up the manufacture of the upright drills which have heretofore been manufactured by the American Tool Works Company, and will also manufacture the Streit pulley lathe. Its works will be in Cincinnati.

Obituary

James Henry Gerry, inventor of the self-winding clock and the gravity escapement in clocks, died December 30 at his home, in Brooklyn, N. Y. He was born in Lowell, Mass., 78 years ago. He learned the trade of watchmaker when a young man, and was employed by the leading watchmakers of the country at different times. Before he retired in 1904 Mr. Gerry had been for fifteen years the superintendent of the Self-Winding Clock Company of Brooklyn.

James Clayton, who was well known as an inventor, died December 31 at his home, in Brooklyn, N. Y., 85 years old. He was born in Shropshire, England. Coming to this country in 1849, he went to Nevada, where he was successful in gold-mining operations. In 1864 Mr. Clayton began manufacturing water and other pumps in Brooklyn. He invented many kinds of pumps and mechanical processes. His best-known invention was the air compressor which bears his name. He retired from business five years ago.

Ernest P. Clark died of cancer on December 12, in the 44th year of his age.

Mr. Clark was a native of Tioga county, N. Y., and his early training there was in a country machine shop. He was not only a mechanic, but also a student; and his versatility was rather unusual.

He was an expert electrician and an active member of the American Institute of Electrical Engineers. At one time he was in the electrical business for himself at 441 Pearl street, New York, and later he became identified with the electrical plant in Altman's store at Eighteenth street and Sixth avenue, New York. Being well posted in chemistry, he at one time opened an assay office. He was also very skilful in electro-deposition and knew how to deposit copper with a tensile strength approaching that of a drawn copper rod. He made many hollow copper articles entirely by electro-deposition and could join two bronze castings by deposition and make a better joint than by brazing.

He devised a suit for submarine divers that was a decided improvement on the existing form, not only as to first cost, but also in regard to ease of application and efficiency in use. He also made an apparatus that rendered an air hose superfluous, which enabled the diver to work with greater freedom, and to explore wrecks without danger of having the air cut off. Mr. Clark had himself been down several times in his diving suit to test its working qualities.

Although an occasional contributor to the AMERICAN MACHINIST, his literary efforts of late were mostly in the automobile line. Among the unfinished work he left behind him was a carbureter that could be adjusted from the outside to give a constant mixture at all speeds, or so that the mixture would vary with the speed and at any desired ratio, either increasing or decreasing; or it could be adjusted to use any grade of gasolene or alcohol. He was somewhat interested in optics and astronomy and had a number of telescopes, some being of his own construction.

As is often the case with intensely technical men, he was lacking in business ability, and promoters of the shady variety used him to further their own ends. Mr. Clark leaves a widow and three children.

Manufacturers

The Nebraska-Moline Plow Company, Omaha, Neb., will enlarge its plant.

Kentucky Electric Company, Louisville, Ky., has purchased site for a new plant.

The Iowa Pump Manufacturing Company, Fort Dodge, Iowa, is building an addition to its plant.

The Waterbury (Conn.) Brass Company will erect three additions including two casting shops.

A new power house is being erected for the Bruer Brothers Lumber Company, Minneapolis, Minn.

The Stevens-Duryea Company, Chicopee, Mass., is erecting an addition to its automobile factory.

The Shreveport (La.) Northwestern Railway Company, recently organized, will erect shops in Shreveport.

The Jensen Manufacturing Company, Topeka, Kans., making creamery machinery, will double its plant.

The Roberts Lumber Company, Minneapolis, Minn., has plans for a new machine shop at its pulp-box factory.

The plant of the Des Arc (Ark.) Hoop and Lumber Company, recently burned, is being rebuilt on a larger scale.

The Milwaukee (Wis.) Refrigerator Transit Company will erect new shops to manufacture refrigerator cars.

The Benedict & Burnham Manufacturing Company, Waterbury, Conn., is about to construct a new boiler house.

A new packing plant, to cost $50,000, will be erected for the East Liberty Home Dressed Meat Company, Pittsburg, Penn.

The United Electric Light Company, Springfield, Mass., is considering plans for an enlargement of its steam plant.

The Latrobe (Penn.) Ice and Provision Company has awarded contract for a $50,000 ice and cold storage plant at West Latrobe.

Hellers Brothers Company, Newark, N. J., file manufacturers, are building two additions to their plant, one to be a rolling mill.

The Lyman Manufacturing Company, of Buffalo, N. Y., expects to be in the market soon for a line of machinery and tools suitable for manufacturing brass valves and malleable unions.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers. 75 Broad St., New York.

Caliper cat. free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Do you want it? Light repair shop southern Vermont. Good business, price right. Box 489, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Medium-weight specialties to build, or will buy or pay royalty for good patented machine or tool. Box 424, AMER. MACHINIST.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACH.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Outside help to manufacture an article requiring a machine shop and foundry. The consumption beyond our output. Steady work. Box 502, AMERICAN MACHINIST.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

Draftsmen in large cities can have a business of their own. Little capital required. Plan sold to only one draftsman in each city. For particulars send stamp. Draftsman, P. O. Box 3566, Boston, Mass.

Not using the whole of our modern factory plant, we should like to take up the building of any small high-grade machines, or parts of machines, in large or small quantities. United Sewing Machinery Company, Springfield, Mass.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Wanted—One 48" engine lathe 21 ft. between centers, triple geared. Two 26" engine lathes 8 ft. between centers. One 26" crank shaper. New for prompt shipment or second-hand if in good condition. Box 491, AMERICAN MACHINIST.

Dec. 26, 1906.

The annual meeting of the stockholders of The Derry-Collard Co. for the election of officers and such other business as may properly come before the meeting will be held at the offices of the company, 109 Liberty street, January 14, 1907, at 5 P. M.

LOUIS ROUILLION, Secy.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company in the Hallenbeck Building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Monday, January 14, 1907, at 12 o'clock noon.

Dated, New York City, Dec. 17, 1906.

F. R. LOW, Secretary.

Business Opportunities

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two second-hand cupolas in first-class condition; shells 72"—82" in diameter and about 40 feet high. Box 333, AM. MACH.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent wants change; American, 25 years' experience manufacturing goods from all kinds of sheet metals, wire and rod. Expert mechanic and designer of tools and fixtures for rapid and economical production. Twelve years in present position; best of references furnished. Address Box 500, AM. M.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MASSACHUSETTS

Draftsman and designer, now employed, wishes to change; accustomed to automatic and special machinery; prefer Boston or locality. Box 498, AMERICAN MACHINIST.

NEW HAMPSHIRE

First-class mechanical draftsman desires change. Box 505, AMERICAN MACHINIST.

Mechanical draftsman, college educated, age 30; experienced in paper and pulp machinery; desires change. Box 504, AM. M.

NEW JERSEY

Position as advertising or sales manager by mechanical engineer with 12 years' experience in office, drafting room, shop, and selling. Has thorough mechanical training, knowledge of advertising, good command of English, and is a clear, concise correspondent. Is a high-grade man and will consider only first-class offer. Address Box 497, AM. MACH.

NEW YORK

Mechanical draftsman, university graduate, is open for a position in factory. Address, W. L., AMERICAN MACHINIST.

A graduated, and on steam engines well experienced mechanical draftsman desires a temporary position. Box 506, AMER. MACH.

Position with concern manufacturing, or going to manufacture, gas or oil engines, by experienced mechanical engineer. Box 482, AMERICAN MACHINIST.

Position in New York City as assistant chief draftsman or superintendent, by energetic young man; designing ability and good executive. Box 501, AMERICAN MACHINIST.

Superintendent desires position; now holding place of responsibility and importance, but change of locality desirable; highest references as to mechanical and business ability and character. Address Box 488, AM. MACH.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

Position as superintendent by thoroughly practical man, good executive, clever designer of special jigs and appliances; up-to-date on best shop practices and organization, cost and time work; at present in charge of engine works; first-class references with twenty-four years' practical experience. Box 490, AMERICAN MACHINIST.

PENNSYLVANIA

Position as superintendent of foundry and pattern shop wanted by a married man, aged 31; thirteen years' practical experience; present position not satisfactory. Box 476, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Good all-around machinists familiar with heavy work; steady work and good wages. Apply at once, Farrel Foundry & Machine Co., Ansonia, Conn.

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

ILLINOIS

Wanted—A man who has had experience making a general line of milling cutters, both solid and inserted tooth, carbon and high-speed steels. Steady work for good reliable man. Box 499, AMERICAN MACHINIST.

Wanted—An experienced superintendent for our plant at Aurora, Illinois. Must be familiar with power transmitting and conveying machinery. State age, experience, where employed at present and length of services in previous positions. All communications kept confidential. Address Stephens-Adamson Mfg. Co., Works, Aurora, Ill., or New York Office, 43 Exchange Place.

KANSAS

Wanted—Good lathe, planer and boring mill men. Good wages, steady employment. No strike or trouble of any kind. Call on or address Independent Kansas Portland Cement Co., Independence, Kansas.

MASSACHUSETTS

Wanted—Young draftsmen on boiler supplies. Apply The Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

Experienced mechanical draftsmen wanted for permanent position with General Electric Co., Lynn, Mass. Send full particulars regarding age, education, experience and salary expected to Engineer in Charge Drawing Office, General Electric Co., West Lynn, Mass.

MICHIGAN

Wanted—First-class man to take charge of test plate testing small steam engines. Address, Box 492, AMERICAN MACHINIST.

Foreman die and tool department—Wanted, a man capable of managing this department in a large factory in southern Michigan, manufacturing steel ranges, summer cook stoves, etc.; must be able to design and make all classes of forming, drawing, perforating and punching dies and special power tools; will also act as master mechanic for entire plant; successful applicant must show actual experience as foreman in this class of work; liberal salary for right man. Address Box 455, AMERICAN MACHINIST.

MISSOURI

Wanted — First-class assemblers; prefer those having had experience on adding machines or typewriters; give references. Universal Adding Machine Co., St. Louis, Mo.

Wanted—Machinists, electricians, engineers and firemen, do you want to "get wise?" Send for 52-page pamphlet containing questions

asked by different Examining Boards sent free. Geo. A. Zeller Book Co., 53 South 4th street, St. Louis, Mo.

Experienced superintendent, familiar with general sheet-metal work and fire-proof windows; take full charge of factory; permanent position for first-class man; state experience and salary wanted. Address H. W., AMERICAN MACHINIST.

NEW JERSEY

Wanted—Mechanical draftsmen on small tool and jig work; state age, experience, references and salary expected. Box 503, AM. M.

Wanted—Lathe, planer, vise and machine hands; good wages for first-class men. The Standard Motor Construction Co., 180 Whiton street, Jersey City, N. J.

Wanted—Toolroom foreman; must be familiar with building of jigs, special fixtures and machinery; modern equipment; location, Newark, N. J. Box 471, AMERICAN MACH.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 458, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Wanted—Party to take charge inspection room of company manufacturing small machinery parts; previous experience preferred, but not required; state particulars; location Newark, N. J. Box 481, AMER. MACHINIST.

Draftsmen—Large works requires competent men with experience on general engineering and construction work; preferably those who have worked on heavy special machinery, power plants, mill buildings, etc.; applications must state age, qualifications, initial salary and references. Box 487, AM. MACH.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

Mechanical superintendent for a machine shop with a well established business. A young, educated, experienced and thoroughly up-to-date man. Only those who state age, nationality, experience, references, salary expected, etc., with full particulars, will be considered. Growing business and an opportunity for the right man. S. B. R., AM. M.

NEW YORK

First-class men on hardening and tempering, also tool dressers. Apply, R. Hoe & Co., 2 Sheriff street, New York City.

Wanted — Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Several first-class tool or die makers on small and medium blanking, forming, and drawing die work. Burdick & Son, Albany, N. Y.

Wanted—Designer on tools and equipment with shop and drafting experience. $20 per week. Adriance, Platt & Co., Poughkeepsie, N. Y.

Steel Salesman—Wanted, a salesman for high-grade carbon and alloy tool steel. Applicants will please give reference and state salary expected. Box 494, AMER. MACHINIST.

Expert brass-foundry foreman on fine castings, false cores, etc.; must know his business thoroughly, be up-to-date and a good executive. Box 486, AMERICAN MACHINIST.

Wanted—A number of first-class lathe, planer, slotter and boring mill hands, for both day and night shift. Steady work and good wages. Apply to Ingersoll-Rand Co., Tarrytown, N. Y.

Several mechanical draftsmen wanted; must have had at least 4 years' actual experience; good salaries to good men; give particulars; location New York City. Box 460, AMERICAN MACHINIST.

Cummings Machine Co., 238 William St., 6th floor, are in need of lathe, planer, milling machine, boring mill, and general hands, accustomed to building machine tools and special machinery. First-class workmen only need apply.

OHIO

Salesman; experienced, to sell portable electrical tools on the road; established line. Address W. Co., Care AMERICAN MACHINIST.

Wanted—First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 288, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Good metal pattern makers. Steady work. Good wages. Address P. O. Box 515, Erie, Penn.

Wanted—General foreman for machine shop, employing 400 men, located in western Pennsylvania. Box 495, AMER. MACHINIST.

Wanted—A draftsman with experience in designing jigs and fixtures for machine tools. State experience and salary desired. Box 496, AMERICAN MACHINIST.

Mechanical draftsmen wanted for detail work with large mining company in western Pennsylvania; applicants must state age, experience, salary expected, and date for entering position. Box 472, AMER. MACHINIST.

Wanted—Mechanical draftsman; young man with shop and drawing room experience. (experience in paper mill machinery preferred). State age, experience, salary expected and give references. Box 493, AM. M.

Wanted—First-class machinists for floor work; must be capable of erecting machines outside the shop and demonstrating; state actual experience in such work. Apply to Stoever Foundry and Manufacturing Co., Myerstown, Pa.

Technical and experienced man wanted to fill position of chief mechanical draftsman with a large mining company in western Pennsylvania; state age, experience, salary expected and date for entering position. Box 473, AMERICAN MACHINIST.

Wanted—An experienced mechanic with good address who understands thoroughly turrets, automatic machines, etc., to represent a well known house with an established trade, calling upon the iron and steel plants in western Pennsylvania and Ohio; state experience, age and salary expected at start. Box 480, AMERICAN MACHINIST.

RHODE ISLAND

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WISCONSIN

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

FOREIGN

Wanted—A competent superintendent thoroughly familiar with the manufacture of special sewing machines with interchangeable parts of modern design. A permanent position is offered with one of the most important German sewing machine companies, in business 40 years, and employing 400 workmen. Applicants must have filled similar position in America, and must be either German, or have a thorough knowledge of the German language. Address giving full information as to age, qualifications, etc., to K. N. 3065, Rudolf Mosse, Köln am. Rhine, Germany.

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Belt Lacing Machine

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
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Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb - Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co, Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington,
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Carr Bros., Syracuse, N. Y.
Fairbanks Co., Springfield, Ohio.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Bulldozers

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

Calipers

Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Wks., Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Brass and Bronze

Lumen Bearing Co., Buffalo, N. Y.
Nolfe Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hopson & Chapin Mfg. Co., New London, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
National Mach. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks., Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Charts and Maps

Derry-Collard Co., New York.

Chisels, Cold

Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines

American Tool Wks. Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co. Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Tool Co., Cleveland, O
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Lathe—*Continued.*

Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Reed Co., Francis, Worcester, Mass.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

National Tool Co., Cleveland, O.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers

Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Correspondence Schools

See Schools, Correspondence.

Cost Systems

American Mechanical Calculator Co., Cincinnati, O.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., New Center, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., New Center, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., New Center, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuue, Iowa.
Becker - Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bertram & Sons Co., Ltd., John. Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Huribut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-Off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford. Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Kent & Co., Edw. R., Chicago, Ill.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

Drawing Boards and Tables
Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Rich, J. & G., Phila., Pa.

Drawing Materials
American Tracing Cloth Co., New York.
Derry-Collard Co., New York.
Keuffel & Esser Co., New York.
Rich, J. & G., Phila., Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B F., Rockford, Ill
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote, Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fichburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial —*Continued.*
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
National Separator & Machine Co., Concord, N. H.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote, Burt & Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Murchey Machine & Tool Co., Detroit, Mich.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Robertson Mfg. Co., Buffalo, N.Y.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room
Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting, and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker - Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene
Atlas Engine Works, Indianapolis, Ind.
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Era Gas Engine Co., Dayton, O.

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We have commenced to move and will operate both plants, old and new, until we are fully settled so our production may be steadily increased with no interruption. We are making many improvements in methods and equipment which will greatly benefit our customers.

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Are now Standard with most American Builders of Machinery, Automobiles, Commercial Cars, etc.

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Engines, Gas and Gasolene —*Continued.*
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Atlas Engine Works, Indianapolis, Ind.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Bormay & Co., New York.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., Wm., Wilkesbarre, Pa.

Fans, Electric
Boston Blower Co., Hyde Park, Mass.
Crocker - Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker - Wheeler Co., Ampere, N. J.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron
Clark Cast Steel Co., Shelton, Ct.
Felton, Sibley & Co., Phila., Pa.

Filing Machines
Cochrane-Bly Co., Rochester, N.Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Sheldon, Conn.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon Co., Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash & Co., Geo., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash & Co., Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott, J. M., Prov., R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash & Co., Geo., New York.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Rivet
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Hyde Park, Mass.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker - Brainerd Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Sons & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Gear Cutting Machinery —*Continued.*
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker - Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker - Wheeler Co., Ampere, N. J.
Dayton Machine & Tool Works, Dayton, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton & Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfied, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

THE U. S. NAVAL GUN FACTORY AT WASHINGTON, D. C.—I

Where Uncle Sam Whittles the "Big Stick" into Shape for Business—The General Layout of the Navy Yard—Historical Facts—Started in 1800 as a Ship-yard—Burned in the War of 1812—An Important Center During the Civil War.

BY H. J. KENNEDY

Since the building of our modern navy, and the demonstration of its power and efficiency, much has been made of "the man behind the gun;" undoubtedly his spirit, faithfulness and skill deserve all the glory they get, but it is likely that there is not quite enough heard of the man who built the gun. This includes, of course, all concerned in the production, not only the man who machines a piece of work of many tons in weight to micrometer accuracy, or who fits together the odd-shaped parts of the sight mechanism which makes the accurate marksmanship possible, but also the man who bends all articles, first, a historical sketch of the navy yard, from the time of its origin, and then to give a general description of the shops in which the work on the big guns is done.

A BIRD'S-EYE VIEW OF THE NAVY YARD

The navy yard is situated in the southeastern portion of the city of Washington, on the right bank of the Anacostia river, or "Eastern Branch" of the Potomac; its northern boundary is M street, S. E., its eastern boundary is Ninth street, S. E., and its western boundary is now Fourth street, S. E., so that it extends east and west, a distance of five city blocks, or about 1900 feet. The width from north to south varies, as shown on the general plan, Fig. 2, and the area is 52 acres. The land sides of the yard are surrounded by a high brick wall, which, except for that around the new extension on the west side, is very old. The ground slopes gradually from the northern limits down to the water's edge, a large portion of it being made ground. The main entrance gate, shown in Fig. 3, is on M street, in line with Eighth street, S. E., at the point where it is intersected by Georgia avenue, which, like the other "avenues" in Washington, runs diagonally. There is also an entrance in the east wall, and another one on M street at Sixth street, where the railroad tracks pass out of the yard.

Upon passing through the archway under the marine barracks at the main gate, we see stretched out before us Dahlgren avenue, inclining gently downward, with the commandant's office at the far end; this was the view given in the AMERICAN MACHINIST, Volume 21 (1898), page 329, (at which time several good pictures of the navy yard were included in the "War preparation number"), though since then the flagstaff has been moved to the corner of the parade ground, as shown in Fig. 4 herewith, and the small house at the corner of Warrington and Dahlgren avenues is replaced by the trim new brick building, shown in Fig. 5, the first floor of which serves as a fire station and waiting room; upstairs is the "brig" or lock-up, and the telephone exchange, where the switchboard is operated by marines. The long brick building which will be the chief object of interest in the description of gun manufacture, viz., the gun shop, extending along the western side of Dahlgren avenue, is divided into three parts, the north gun shop, the south gun shop and the breech-mechanism shop, respectively. The first division is pretty well shown in Fig. 6, which is a view

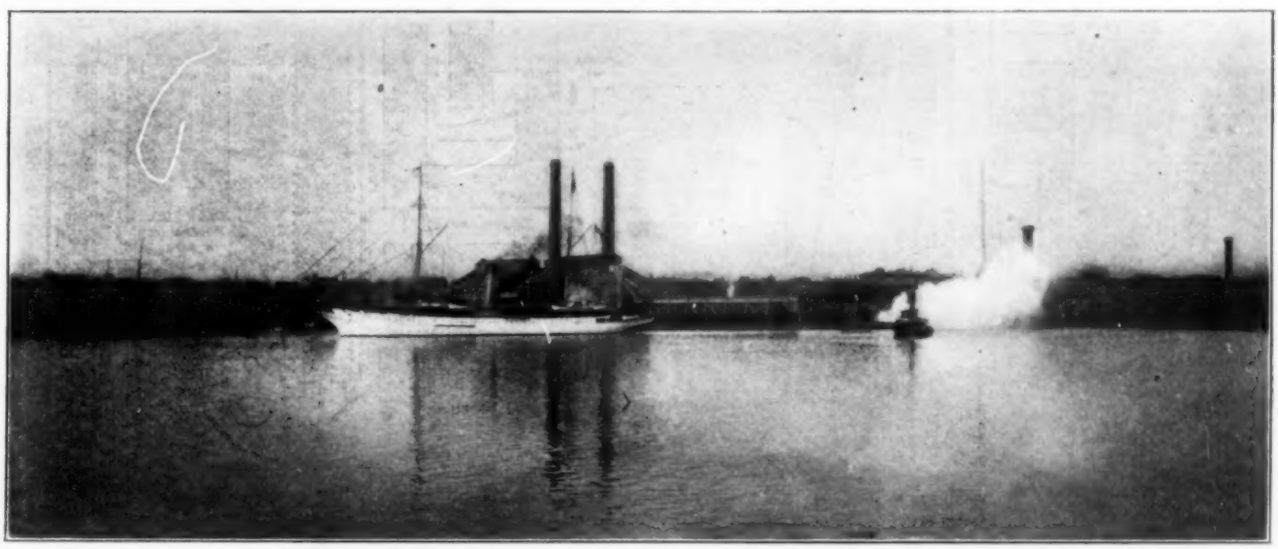


FIG. 1. THE U. S. S. "MAYFLOWER" TAKING PRESIDENT ROOSEVELT ON HIS WAY TO PANAMA, NOVEMBER 8, 1906; WASHINGTON NAVY YARD IN BACKGROUND FIRING SALUTE

day over a drawing-board and seeks to evolve out of his head a design which will beat anything yet made, and the official who sits at a desk and controls the expenditure of large sums of the Government's money. In Washington, a city in which everything of any importance at all is a "sight" for visitors, not the least notable by far of these "sights" is the navy yard, and this not so much for its historical interest, though there is a good deal of that, but because it is here that the United States Government makes the armament without which its naval vessels would be as useless for the purpose for which they were designed as a lot of Chinese junks. It is the intention to give in this series of

looking southwest across the parade ground. Space is obtained for the projecting ends of the long gun lathes and for some other machinery by extensions from the main wall out toward the street, light being afforded by skylights, some of which show in Fig. 6.

The gun-shop building, which, when the breech-mechanism shop at its south end is included, is 926 feet 5 inches long, and

The bird's-eye view, Fig. 7, will assist in forming a correct idea of relative location, though it is not a recent picture, and like the picture of 1898, just referred to, shows some things which have now been altered. This view is looking southwest and shows the gun shop in the middle, parade ground to the left, beyond which are buildings for stores, seaman gunners' quarters, offices, etc. On the right, with a

This view is looking northeast, and in the background to the right is the gun-shop building, which has since been extended farther south. On the site of the building in the foreground now stands a new brick forge shop.

THE RESIDENCES

Along the northern boundary of the yard, on the highest ground, and farthest

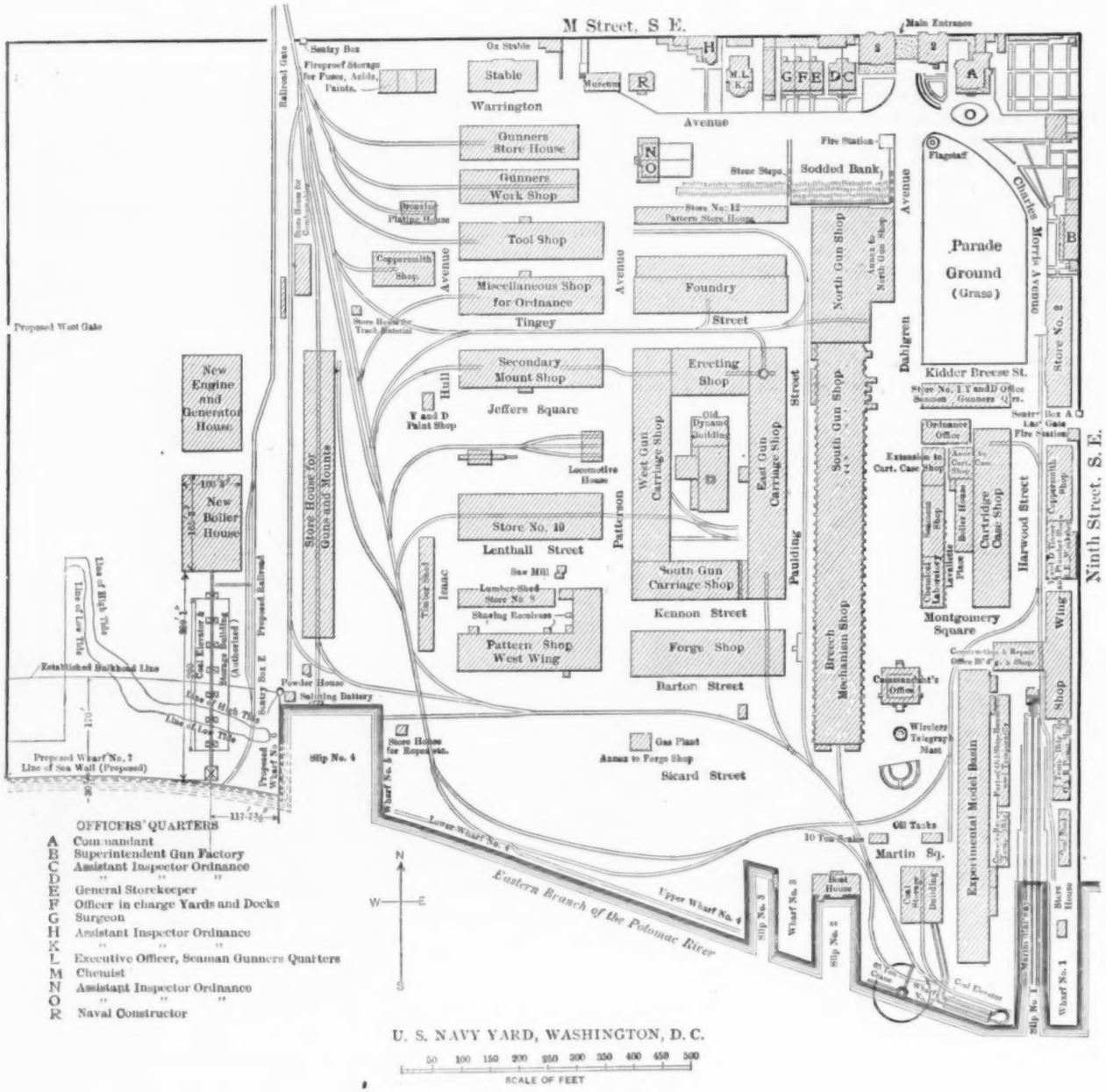


FIG. 2. MAP OF THE NAVY YARD

from 80 to 140 feet wide, and the gun-carriage shop or quadrangle, are the largest buildings in the yard, their area taken together being not very far short of the aggregate area of the smaller shops, including the secondary mount shop, the miscellaneous-ordnance shop, the tool shop, the forge shop, foundry, the pattern shop, and the cartridge-case shop, together with the various store-houses.

brick smoke-stack sticking out of its middle, is the "quadrangle," and south of this building is the river, the extreme background being formed by a portion of the District of Columbia; Alexandria, Va., being on the horizon on the extreme right.

The quadrangle, or gun-carriage shops is shown in Fig. 8, which is not a recent view either, and does not show some of the additions and alterations since made.

from the river, with its more or less malarial mud shoals, are located the dwellings for the officers and others stationed at the yard. As already stated, the marines are quartered in the building spanning the main gate and lying on each side of it; to the east of this building is the commandant's house, and farther around, down by the eastern wall, is another official residence known as the superintend-

ent's house. To the west of the main gate, along Warrington avenue, is a row of brick dwellings, with a museum of historical relics at the end. The *residential* portion of the yard, like a large portion of the city of Washington, has a sedate Southern aspect; the houses have porches, sometimes on two stories, and have trees and small gardens in front of them, protected by ornamental iron railings, their general character being shown by some pictures to be published in the next article. The commandant's office at the foot of Dahlgren street is of similar architecture.

FIG. 3. MARINE BARRACKS AND MAIN ENTRANCE GATE, LOOKING OUTWARD

HISTORIC GUNS

At various points in the yard are historical cannon, principally guns captured by ships and privateers of the United States from the earliest days of its existence up to the Spanish-American war. On the lawn or small park in the rear of the commandant's office, are many of these guns, most of which are closely placed around a big semi-circle. Going the rounds of a great number of curiosities is likely to be somewhat tiring, and the mere cataloging of them still more so, so it will be omitted here; suffice it to say that the student of the development of ordnance will find at the Washington navy yard a very considerable amount of historical material.

To the west of the long gun shop, and occupying the middle of the yard, are the numerous other buildings of the gun factory, some of which will be referred to in detail later on. At the southeastern corner of the yard are the buildings of the Bureau of Construction and Repairs, including its offices, drafting-room, etc., and the experimental-model basin, of which a good illustrated description was given in the AMERICAN MACHINIST, Volume 22 (1899), commencing at page 612. North of these buildings are the cartridge-case factory, offices and other structures, as indicated on the plan, Fig. 2.

The principal objects of interest on the western side of the yard are the long building for storage of guns and mounts, the "wireless telegraph" station, and the new electrical power station, which is housed in two buildings, the northern one being the engine and generator house, and the southern the boiler house, in connection with which are extensive arrangements for the storage and handling of coal.

Having made this brief survey of the navy yard, we will go back to its early days, when it used to build the old wooden frigates, and note its gradual decline as a shipbuilding plant, and the growing importance of ordnance construction until at the present time this yard has become preeminently a gun factory, the details of which will follow.

FIG. 4. PARADE GROUND, LOOKING SOUTHEAST

THE EARLY BEGINNING OF THE NAVY YARD AT WASHINGTON

The Washington navy yard dates back to the beginning of the nineteenth century, to the administration of the second president of the United States, John Adams. The necessity for means of protecting the commerce of the United States, together with the representations of the first secretary of the navy, Hon. Benjamin Stoddert, impelled Congress to make an appropriation in 1799 of $1,000,000 for the building of six fighting ships of the largest size, and a portion of the appropriation was employed in the establishment of six navy yards, located at New York, Philadelphia, Boston, Portsmouth, Norfolk and Washington. At the latter place 40 acres were, in March, 1800, purchased for $4000.

THE ARCHITECT OF THE CAPITOL MAKES PLANS FOR THE NAVY YARD

Architect of United States Public Buildings B. H. Latrobe drew up a scheme for the improvement of the grounds and layout of the yard. On each side of and above the gate were located a house for the accommodation of the guard, which structure was to be built of a species of durable freestone, only half the price of that used in the Capitol, and which, though not of so fine a grain, is quite as strong and capable of resisting the weather. On account of the conditions at the water front it was necessary to make a large quantity of ground, and an important feature of the early work was the construction of a substantial wharf. Slips for building the frigates, a derrick crane for handling masts, guns, etc., a canal to lead into the interior of the yard, timber sheds, sail lofts and shops for the various "artificers" concerned in the building of wooden ships were among other features of the design. Mr. Latrobe in his outline says: "In the center of the upper part of the yard I propose that the first officer of the yard shall reside, as does the com-

mander of the King's yard in England and the intendant formerly in France." Residences for other officers and "master artificers" were also included.

COMMENCEMENT OF THE WORK

This plan was approved by the secretary of the navy and was gradually executed, with some interruptions and modifications. The superintendent of the yard was Captain Thomas Tingey, of Kingston, N. J., who was appointed January 22, 1800. In 1804 he was given the title of commandant. This officer took a close interest in the building up of the navy yard and the direction of the work done there, and he left behind him, with reference to these matters and covering many years, a voluminous correspondence—all in his own handwriting—how different those times were from the present typewriter age!

A CHANGE OF POLICY—A NAVAL MILITIA INSTEAD OF A NAVY

Upon the election of Thomas Jefferson to the Presidency, March 4, 1801, the policy of Congress became to gradually and permanently abolish the navy, rather than to establish it permanently and increase it, Mr. Jefferson's theory being that war is unnecessary and that a powerful navy is a continual challenge to war. Hence Congress passed a "Peace Establishment Act," which reduced the naval personnel to nine captains, 36 lieutenants and 150 midshipmen, and provided for a reduction of the navy, by sale of the vessels, to a fleet of 13 frigates, only six of which should be kept in commission. For some years thereafter several frigates were lying in ordinary at the Washington navy yard.

During 1805 the navy yard sent supplies to the Mediterranean squadron, which was maintained for the protection of the United States commerce against the freebooters and pirates of the Barbary States.

Instead of a navy, Mr. Jefferson's plan was to have a system of gunboat defense for harbors and coasts, the gunboats to be kept housed in sheds or drydocks in time of peace and in war they were to be manned and officered by volunteer seamen or militia from the towns attacked. Harbors were to be protected by a sort of flying artillery, carried to the points where needed, no permanent fortifications being required according to this scheme.

BUILDING GUNBOATS IN THE EARLY DAYS

Accordingly, in 1805, Congress appropriated $250,000 to build gunboats, not over 50 in number, "for the better protection of the harbors, coasts and commerce of the United States," and by the beginning of 1806 three gunboats had been built at the Washington navy yard at a cost of from $10,000 to $15,000 each. However, in spite of this policy, an appropriation of $660,000 was obtained in 1805 for the building of six line-of-battle ships.

It is interesting to note the wages paid in those days—laborers getting 75 cents a day and various kinds of mechanics from $1.25 to $2, the highest being the rate for first-rate ship carpenters. No machinists nor millwrights are enumerated.

From this time on the Washington navy yard was a center of much activity in the construction of ships, repairing and fitting up of the old ships, and furnishing of guns, supplies and ammunition to various points.

In 1807 Robert Fulton got authority from the secretary of the navy to test a submarine torpedo invention at the navy yard, but for lack of funds he was not able to accomplish anything. It is quite possible that had the steamboat man been supported in his efforts, the United States might have, at this early date, been the possessor of a torpedo system, with very important results.

Up to the destruction of the navy yard by fire in 1814, there were experimental efforts made to manufacture within the yard not only armament, but every piece of nautical mechanism required by a man-of-war, for instance, pistols for the ships, and mathematical instruments.

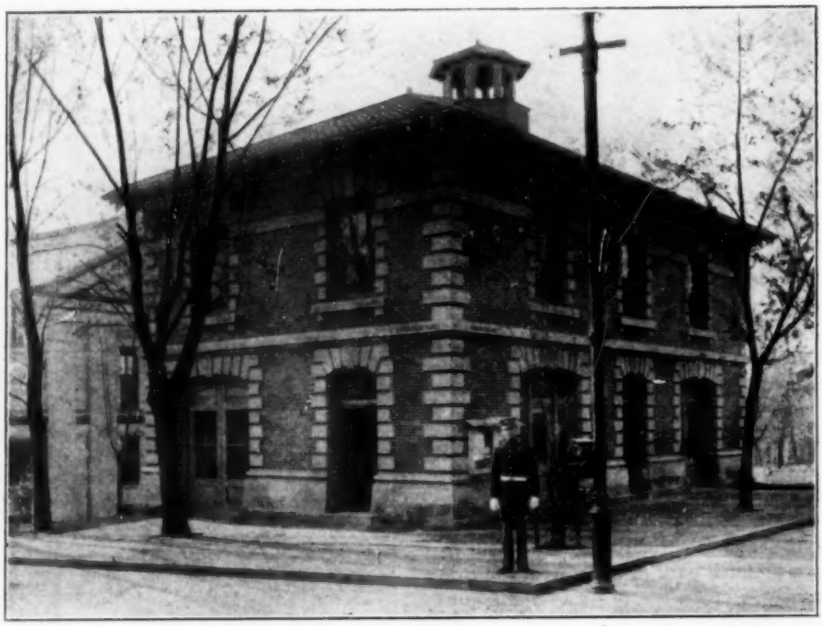


FIG. 5. NEW BUILDING FOR FIRE STATION, "BRIG," WAITING ROOM AND TELEPHONE EXCHANGE

The names of some of the vessels which were overhauled in the years 1811 and 1812 are familiar to readers of United States history: thus we have the brigs "Vixen" and "Hornet," the schooner "Enterprise," the ship "Wasp," the frigates "Congress," "Constellation," "Constitution" and "Adams."

Mr. Jefferson's pet gunboats, according to the accounts of the time, did not realize expectations, but proved a costly failure.

THE NAVY YARD COMES TO GRIEF IN THE WAR OF 1812

The war with Great Britain was declared June 18, 1812, and from this time there was a great scarcity of naval officers at the navy yard. There was also a surprising neglect to put the yard in any sort of condition of defense, in spite of the British ships being present in the Chesapeake bay, steadily engaged in pillage, burning and killing; this indifference even went so far as to cause to be voted down a Congressional resolution to make preparations for a successful defense of the capital of the nation, with the result that the British General Ross and Rear-Admiral Cockburn, with a few thousand men, no cavalry, and very light artillery, had no difficulty in taking possession of the city on August 24, 1814, and burning the Capitol and other public buildings. By order of the secretary of the navy, as soon as it was seen that the situation was hopeless, Captain Tingey applied the match to the buildings in the yard and the shipping, just about the same time that the British were burning the Capitol, the Treasury, the "president's palace"—as the British general called it in his report—and other public properties; Captain Tingey made his escape in a boat, and the enemy shortly after occupied the yard and finished things up to their satisfaction. This easy invasion and destructive indignity to our national capital, which might have been avoided by proper preparations and good management, and which caused great public humiliation and chagrin, was a contrast to the reception which the citizens of the neighboring city of Baltimore gave to the invaders, resulting in their repulse by volunteers and the killing of General Ross on September 12, 1814, at the "Battle of North Point," several miles from Baltimore, which event is commemorated by a monument in the "Monumental City," and is still celebrated there by an annual municipal holiday. The naval attack on Bal-

timore at the same time, the fruitless bombardment of Fort McHenry, and the writing of "The Star-Spangled Banner," by Francis Scott Key, are celebrated incidents of this same campaign.

ANOTHER START

In the latter part of the year 1814, President Madison appointed Benjamin N. Crowninshield secretary of the navy, to succeed William Jones, and in the following year, Congress having made an appropriation for the purpose, the work of rebuilding the navy yard began. New buildings were erected, and the construction of

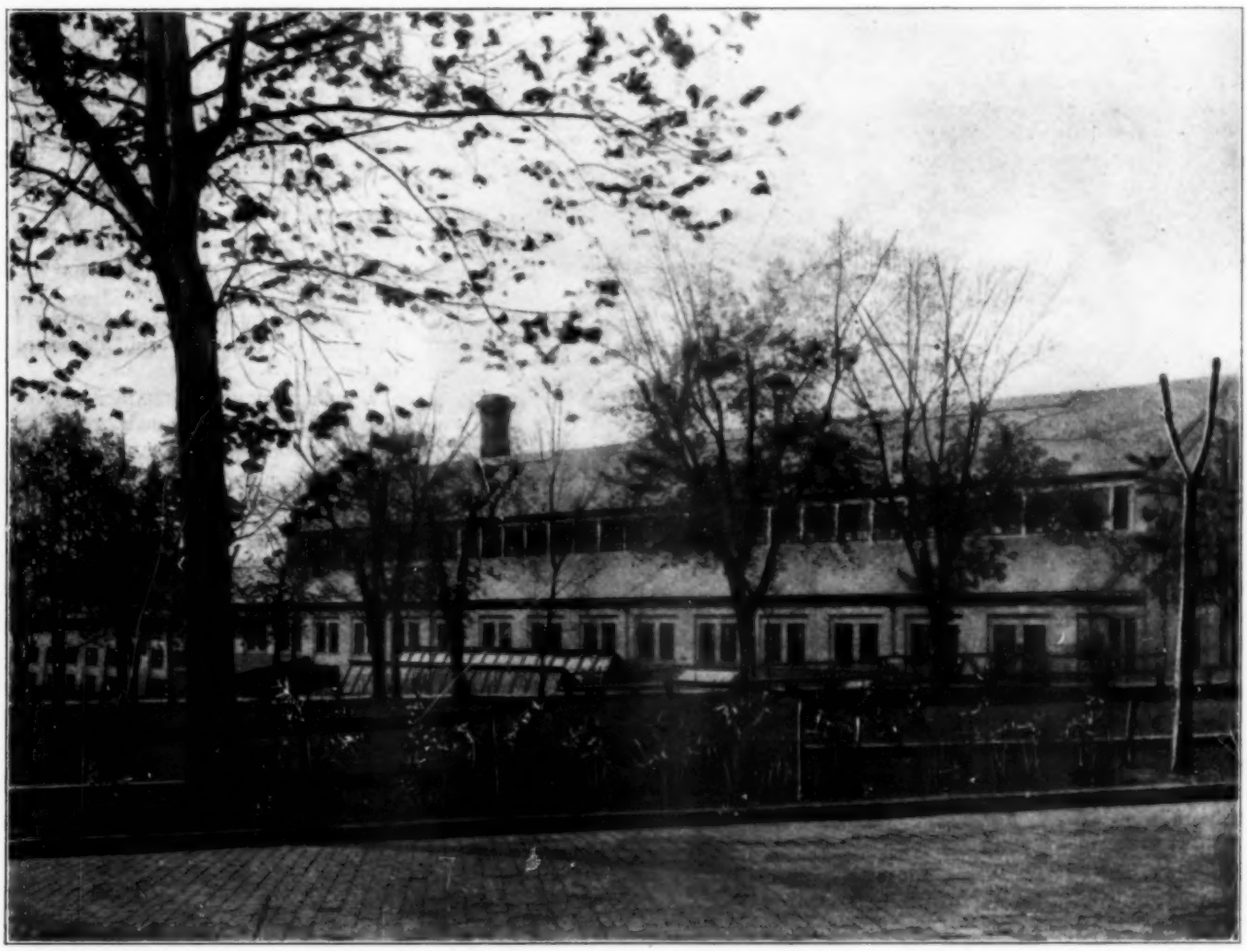


FIG. 6. THE NORTH GUN SHOP, LOOKING ACROSS PARADE GROUND

frigates, schooners, and other craft was resumed. During the ensuing years, improvements were steadily made at the yard; besides various shops, sheds, storehouses, dwellings, etc., there were built a brick wall around the land sides of the yard, wharves, building slips, and an inclined plane with a house over it.

At the first session of Congress in 1824, a bill was passed arranging the navy yards into classes, and the navy yard at Washington was named in the first class.

On February 23, 1829, the navy yard lost its able and conscientious commandant, Captain Tingey, who died in the 78th year of his age, having served under the administrations of John Adams, Thomas Jefferson, James Madison, James Munroe, John Quincy Adams and Andrew Jackson. He was succeeded by Commodore Isaac Hull, who was appointed by Secretary Southard to the position of "Commandant and Naval Agent," the same as Captain Tingey held at the time of his death; the latter office, however, he was later glad to be relieved of. Commodore Hull assumed command on April 11, 1829.

THE SHIPYARD DECLINES IN IMPORTANCE

At the beginning the Washington navy yard was designed to be first in importance, and was so regarded and designated for over a quarter of a century. But the increasing shallowness of the Eastern Branch, which, like many other American rivers, has a tendency to fill up its bed, and other changes resulting from the growing wealth and importance of our seacoast cities, caused attention to be attracted to the navy yards lying adjacent to these cities, and to the necessity for making them equal to the demands that their surroundings, their deep and capacious harbors, and their proximity to the ocean created. Gradually the Washington navy yard ceased to be a resort of ships needing repairs, and the yards at New York and Norfolk almost entirely supplanted it in this work, and also to a considerable degree in building new ships.

The commissioners of the navy considered that the places of general rendezvous should be the Chesapeake bay, and the waters at or near Newport—Boston navy yard being an auxiliary to the latter; and the connection of Washington navy yard with the Chesapeake, its valuable plant in which a large amount of money had been invested, and its proximity to the Capitol, made it still a yard of much importance, but for the reasons mentioned this yard could no longer be considered as a yard of the first class.

Nevertheless, in 1832 the wharf was enlarged, and the south side of the yard filled up, and various other improvements made, $40,000 being expended thereon. During the following years many other thousands of dollars were spent on repairs and improvements. Up to 1832 the following live-oak vessels had been built at the Washington navy yard: Five frigates, two sloops and two schooners.

In 1835 Commandant Hull requested to be relieved from the command of the yard, on account of the declining health of his wife, which request was granted, and he

was given letters to the officers of the Mediterranean squadron to allow him to spend the time with his family in those waters.

The navy yard was then successively commanded for short periods by the following officers, the latter two of whom died there: Captain John Gallagher, Captain Daniel T. Patterson, Captain Thos. Holdup Stevens. At this period steam navigation was receiving much attention from the navy department, and the strength of these cables, analyses of coals from the United States and England on account of the promised importance of steam as a motive-power for ships; recommendation for the building of a permanent iron foundry in place of the improvised affair which had fomerly served; the blowing up of an old hull by a submarine invention of Samuel Colt, renowned for his pistols, and the building of small iron steamers.

In 1846, Captain Aulick was succeeded

FIG. 7. BIRD'S-EYE VIEW FROM MARINE QUARTERS, LOOKING SOUTHWEST; POTOMAC RIVER IN BACKGROUND

one of Captain Stevens' earliest letters to the department was a request for three midshipmen to be detailed to the station in order to improve themselves in steam engineering.

In 1840, $20,000 were appropriated for improvements and repairs. In 1841, Captain Beverly Kennon was appointed commandant. This officer also was an advocate of having a large number of midshipmen at the yard, principally on account of the excellent opportunity for the study of steam navigation and "enginery," and his request was acceded to.

ESTABLISHMENT OF THE BUREAU SYSTEM IN 1842

Prior to 1842, navy yard affairs were conducted by the navy commissioners, with the secretary at the head. At that date the bureau system was established. There were originally five bureaus—yards and docks, construction, equipment and repair, provisions and clothing, medicine and surgery, and ordnance and hydrography.

In 1843, Captain Kennon was detached from the command of the navy yard to take another important assignment, and he was succeeded by Captain J. H. Aulick.

THE COMING OF THE AGE OF STEAM AND IRON

We find the hand of modern science making its appearance, as instanced by numerous rigorous experiments on iron for chain cables, processes for improving

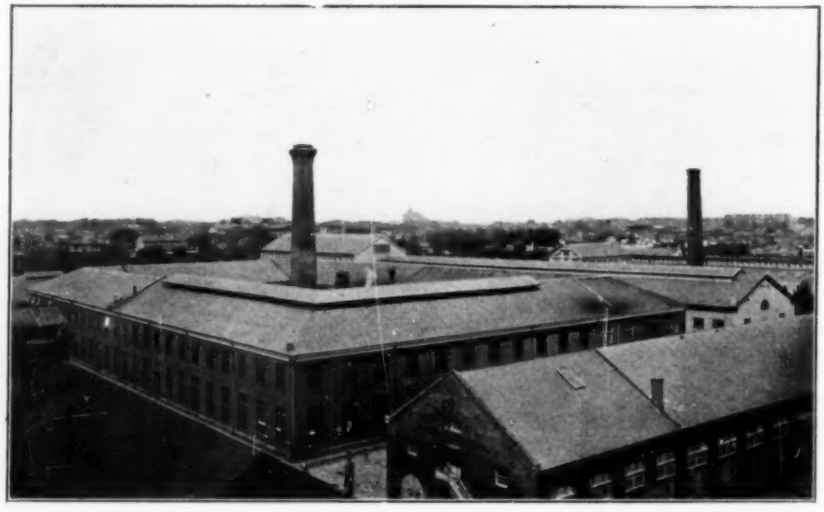


FIG. 8. GUN-CARRIAGE SHOP QUADRANGLE

in the command of the yard by Captain W. Bradford Shubrick, but, in the same year, as he wished to take some part in the Mexican War, he was appointed commodore of the Pacific squadron. In September, Captain Chas. S. McCauley was appointed to the command of the navy yard.

In this year No. 11 timber-shed was converted into an iron foundry, new forges for chain cables and five large anchor forges, and a large trip hammer, and other improvements were effected.

MECHANICS EARNED SOMETHING IN 1848

For the year ending July 1, 1848, the cost of labor at the yard for building, repairing and equipping vessels, etc., was $90,451.73. An engineer and machinist received $1800 a year, a master tank and camboose maker $1250, a master chain and anchor maker $1250. Among the estimates for 1849, we find machinery for making ordnance stores, including a boring mill, and a "large turning and planing lathe," whatever that might have been.

In 1850, a permanent stone wall, to replace the wooden wharves which had become rotten and unsafe, was commenced.

AT THE MIDDLE OF THE NINETEENTH CENTURY, ORDNANCE WAS AN IMPORTANT PRODUCT AT WASHINGTON

The secretary of the navy in 1850, referring to the Washington navy yard, stated that it was carrying on a highly important manufactory of ordnance and ordnance stores, of anchors, chain cables, steam engines, and other fabrics of iron, and a building was then in progress in which to erect machinery for rolling copper, an establishment long wanted, as well on the score of economy as to furnish a better quality of rolled copper for sheathing vessels than could be obtained in the market.

A DISTINGUISHED ORDNANCE OFFICER BUILDS UP THAT DEPARTMENT AND ALSO HIS OWN REPUTATION

The ordnance department, under Lieutenant John A. Dahlgren, had at this time grown greatly in activity and importance. Improved brass howitzers to be used as boat or field guns were being made, also shells, fuses, primes, gun sights, etc., and experiments were made to obtain accurate information about the ranges, etc., of the guns in use.

The stone wharf was completed, railway and copper-rolling mill built, ordnance building, "slide lathes" in machine shop, and other improvements effected. The gun-carriage shop, ordnance building

and marine railway were under way in 1854. The boiler and entire machinery for the "Minnesota" were built at the navy yard.

Lieutenant Dahlgren, who had been in 1847 ordered to ordnance and equipment duty at the navy yard, showed great natural aptitude for this department of military science, and in a few years became an authority on the subject. The principal street in the navy yard very appropriately bears his name.

FREAK INVENTIONS EXAMINED

Many inventions were examined and experimented with at the yard to determine the feasibility of their use in the navy. "A liquid fire" and "a shot-proof steamship" were among those presented in 1847. The board of examiners very decidedly turned down the former; it does not appear what they reported as regards the latter. It would be a bold inventor who would make such a broad claim in our age of increasing weights and velocities of projectiles. As early as 1849 Lieutenant C. G. Page had a scheme for rapid locomotion by "electric magnetic motor power."

In the next few years the yard changed commandants several times—Captain Henry E. Ballard, Captain Morgan, Captain Hiram Paulding, Captain French Forrest, Captain E. A. F. Lavallette, Captain John Rudd, and finally, in 1859, Captain Franklin Buchanan occupying the position. During this period there was done considerable experimenting with ordnance and projectiles.

THE PRESAGE OF WAR

In 1861, in consequence of rumors of an intended seizure of the navy yard by a mob in order to obtain arms and ammunition to prevent the inauguration of Abraham Lincoln, secret preparations were made to defend the yard, and, in February, Commandant Buchanan issued an order setting forth a scheme for defense, which, however, fortunately was not required. But, although Captain Buchanan was ready to thus defend his command against a mob, his sympathies were with the Southern States, and upon being ordered to equip several vessels for war service, he resigned his commission and cast his fortune with the Confederates. Practically all the officers of Southern birth attached to the yard did the same thing.

THE DEPARTMENT OF ORDNANCE COMING TO THE FRONT

At this time the Washington navy yard was the only one prepared to complete a marine engine. Nevertheless the inevitable tendency of this yard to become an ordnance yard is shown as early as this, when, in 1859 and 1860, although the amounts of time and money for labor in other departmeits in this yard were less than that of the smallest of our other navy yards, in the *ordnance* department of the Washington navy yard the number of days of labor and the cost thereof were both more than that of all the other yards combined.

THE NAVY YARD DURING THE CIVIL WAR

Immediately after the resignation of Captain Buchanan, Commander John A. Dahlgren was appointed to the temporary command of the navy yard, and a few months later, he having won the confidence of the secretary, of the President, and of Congress, the latter body passed a special act, making Commander Dahlgren, although he lacked the rank of captain, eligible as permanent commandant of the yard. The Civil War having now started, and in view especially of the location of Washington between the States of Maryland and Virginia, which States were permeated with sympathy for the Southern Confederacy, this position was one of great responsibility and much difficulty. A flotilla was placed on the Potomac, and the commandant of the Washington navy yard, besides the administrative and technical duties immediately relating to the navy yard itself, practically became the "adjutant-general" of the navy department and the medium of communication between the navy department and the army and navy operating upon the Potomac and its shores. This was then a much more difficult duty than it would be now in these days of wireless telegraphy.

In June, 1861, an oath of allegiance to the United States was administered to the employees of the yard, 37 of whom were dismissed for refusing to take the oath. The yard at this time was occupied and guarded by a battalion of troops.

COMMANDER DAHLGREN HANDICAPPED BY LACK OF MACHINERY, ETC.

The following extract from one of Commander Dahlgren's letters to the department gives a good idea of the conditions prevailing:

"At this period the number of light cannon that this department can supply is about two rifled bronze guns per week, which is by no means what it should be or what can be attained. But this includes the two carriages (for field and boat) which require even more work than the gun, and the full supply of ammunition, equal together to five guns per week. . . . As soon as the work on the 'Pensacola' is completed" (this ship was then being supplied with new boilers and steam apparatus at this yard), "I shall be able to apply the machinery of the engineer department to ordnance, and see no reason then why the product should not be one gun per day, or 300 per year. I acknowledge the shortcomings of this department, but, in justice to myself, must say that they are not attributable to myself, but to the miserable short-sighted policy that has been permitted to control the navy ordnance for more than ten years, and has overridden me in all the suggestions I have submitted.

"Some of these have been absolutely ignored and rejected, such as experiments on armor for ships in 1852; rifled cannon in 1856. Others have been curtailed or crippled so that their usefulness has been but partially developed. This was signally the case with the system of armament that I proposed for our heavy frigates which was mutilated in the most injudicious manner, essentially reducing the power of the batteries. So with the expenditure of $100,000 for small arms.

"In this department as soon as my back was turned my arrangements were even entirely reversed. Thus, when I went to sea in the 'Plymouth,' the chief of the bureau countermanded the making of a large gun lathe upon which the finish of certain ordnance depended. So that even in this matter of detail I was powerless, save what was derived from the bureau. I am entirely discouraged by this constant difficulty, which has only taken different forms under different chiefs, without losing force or direction."

THE WAR MADE BUSY TIMES AT WASHINGTON

The defense of the yard was not neglected this time, as in the war with Great Britain. A naval battery was installed and manned by a force of seamen and marines. The Chesapeake bay flotilla brought to the navy yard various vessels which it captured. The navy yard was kept very busy equipping ships and providing war material. In 1862, in consequence of Act of Congress setting the hours of labor in the navy yards to be the same as those in the nearest private ship-yards, the hours in the Washington yard were made the same as those in Baltimore, namely, ten hours per day.

In 1862 three more bureaus were added to the department, viz., steam engineering, equipment and recruiting, and navigation.

Commandant Dahlgren was at this time very insistent in his recommendations for appropriations for increasing the facilities of the ordnance foundry, especially in view of the increasing demand for heavy ordnance which could be used against ironclad vessels.

PREPARATIONS FOR DEFENSE AGAINST THE ANTAGONIST OF ERICSSON'S "MONITOR"

Students of naval engineering, and in fact all engineers and mechanics, find great interest in the origin of the monitor type of war vessel, the story of which is inseparably linked with the vessel known best by its original name of "Merrimac." This old United States frigate, which the Confederates had rescued from the wreck of destruction at Gosport navy yard, renamed "Virginia," and so armored as to make her invulnerable against any batteries of our navy then afloat, was exciting a panic of fear along our entire Atlantic coast. The commandant of the Washington navy yard made preparations to defend the Potomac against this new terror by erecting a battery (including an 11-

inch gun) and by sinking in the channel a lot of canal-boats loaded with stone.

The United States Government endeavored at this time to obtain from the various iron manufacturers of the country specimen iron armor plates, in order to test at the Washington navy yard their resistance to shot, but these people were too busy making plating for the vessels building under Captain Ericsson's directions, and no plates could be obtained. We presume they obtained some later on, however.

THE MECHANIC AS A FIGHTING MAN

The mechanic's is usually considered a peaceful art; however, the employees in the yard at this time got, in a manner, some taste of war, inasmuch as some of them had at times to go out on some expeditions in the service of the Government. For instance, in 1862 such an expedition went to Harper's Ferry along with several howitzers, gun carriages and ammunition. One of the employees in the yard was dismissed because he didn't want to fight on either side, though whether he objected to fighting in general, or couldn't decide upon which side he ought to fight, does not appear.

Report in Favor of a Floating Machine Shop for the Navy

As our readers may remember, we gave in 1898 a good description with illustrations of the navy's floating machine shop "Vulcan," page 609, Vol. 21; and at page 867 in the same volume some account of how this vessel made itself useful during the Spanish-American war. We note that in his recent annual report, the chief of the Bureau of Ordnance, U. S. N., calls attention to the desirability of equipping an auxiliary vessel for use as a machine shop and store vessel with the fleet, which would be particularly desirable in view of what now seems to be the policy of the Department—fleet cruising instead of independent service for the larger vessels. Admiral Mason states that on such a vessel numerous minor repairs and modifications in ordnance, as well as in other departments, beyond the capacity of the machine shops of the vessels themselves, could be made at once, instead of having to send the vessel to a repair yard or wait until a favorable opportunity for the absence of the vessel from the fleet. In addition, this auxiliary vessel could well carry a full supply of stores and spare parts of all kinds, thereby allowing a very material reduction in the amount of stores, spare parts, and material ordinarily carried on board each ship, and increasing space and decreasing weights which could well be used for additional coal or ammunition supply.

A kilowatt-hour of electricity will pump one hundred gallons of water to a hight of twenty-five feet.

ECHOES FROM THE OIL COUNTRY

High-pressure Gas Engines—Good Machinery that it Pays to Have Idle

BY W. OSBORNE

No other power developer has ever had the wide distribution and universal use that has fallen to the gas engine in its earliest form. The time of its invention is in doubt. Not considering the claims of the Chinese, they were certainly used in the fourteenth century. Today they can be found in every part of the world, and are known and used by savages who do not use very much else of civilization.

While many of the details of these early engines have been changed, the general construction has been changed so little that no matter to what period one belongs it is never mistaken for anything else when seen. It has always been the practice to have the producer plant for making the gas permanently attached as part of the engine.

A relative of mine who is quite generally known as Uncle Sam has some very nice machines of this class, and along with quite a number of his nephews, and some of his nieces, I had the pleasure of looking over part of them at one of his residences. While some of the types of these engines are very common (in fact I own and have experimented with several of the types myself), yet these are very large and finely constructed and cared for, and are worth going a long way to see.

RANGE OF SIZES.

I might say in passing that very many sizes of these engines are made. I understand that the sizes have ranged from 7/32 inch to 30 inches for the bore, and that the stroke has been all the way from 6 to 50 times the bore, although I am not sure that these sizes at all represent the extremes either of the bores or of the strokes.

These engines are never used to run constantly, and while the piston velocities are very high, the number of strokes possible in a given time is not.

THE STARTING PROBLEM SOLVED.

In certainty of starting, these engines leave very little to be desired, the main efforts of designers being directed to getting higher piston speeds, more perfect alinement, reduced weight, a greater number of strokes in a given time, greater ease in handling, etc.

While the use of these engines is so universal, the starting of them is always attended with some danger, and Uncle Sam has a body of men especially trained to handle his, so that they may not do any injury to his friends. In our visit a number of these men were at hand to see that visitors were kept out of harm's way, and while the behavior of such of these gas engines as were started for our instruction may have been somewhat different from what we desire in our shop-engine, yet it was according to the best practice in the lines on which the various types were built.

Four of these which might be called verticals, or inclined angulars, or some such name if they did not have a better one, were started at once.

EXHAUST PRESSURE AND PISTON SPEED

The noise of the exhaust was terrific, and the pistons went sailing away at a great rate. Two of them I could see very plainly until they passed out of sight. Others of the group said that they could see another one, not far from these two, which seemed to be quite close together.

I do not know what the piston speed of these engines is, but on some of the others it ranges between 2000 and 3000 feet per second. The piston on an engine of 12-inch bore weighs about 1000 pounds, while one for the 16-inch engine weighs 2400 pounds. As it requires a new piston for every stroke of the engine, and as the pistons are made of a high grade of steel, we could not expect the larger engines to make many strokes for us to admire.

There is one device in use that shows high mechanical and commercial insight. The main purpose of these large gas engines is to be able to perforate plates of various thicknesses. These plates are movable and the owners of them often do not want to have them perforated, and, while they may very much desire to keep them in the immediate vicinity of the punching machines, they do not want to have the pistons come in contact with them. It can thus be seen that the men who run the gas engines have to have practice in so directing the open end of the cylinder and in gaging the proper moment of starting as to counteract the efforts of the parties with the plates, as those efforts are directed to getting the pistons wasted.

BUSHED CYLINDERS

To get this practice without the very great expense that would attend the use of full-sized pistons and the amount of fuel necessary to supply the gas used for the explosion, a small cylinder is mounted in the center of the large one. Care is taken that the center lines are the same for both of the cylinders, and that the center lines of travel will be the same for each piston after it has left the cylinder. By this arrangement the practising may be done with the smaller

cylinder and the same skill be acquired as though it were done with the larger one. The work of handling the engine, and of placing it in the position in which it is to do its work is the same in either case, although the men do not have to handle the heavier piston in the practice work.

When it is understood that the material to be operated on is often several miles away and in motion, it can at once be understood that the action of the large and of the small cylinder must be very closely alike. It can also be seen that the pistons for either must be very closely alike, and the quanity of the gas-producing material and its quality be kept uniform, and be so made that it will not deteriorate with age. It is never known with certainty when a job of work will be on hand for them, and so they are kept in constant readiness.

These engines are very costly in first price, and even more so in their foundations and in the operatives who are kept constantly on hand; but in spite of the expense of keeping them in readiness for instant use and having the operatives trained up to the very highest point of skill, no one really desires to see them put at the regular work that they were made to do. They are one class of machine that is better without being kept busy. It is better to have them get out of style and be thrown into the scrap pile than it is to have them worn out.

LIMITED TESTING

In some types of gas engines, it is necessary that the new ones be given rigid tests before being allowed to go away from the works to the final user. In going through these tests, each engine has to make many strokes, nearly always many thousands, and sometimes tens of thousands. With this style of gas engine, before one of the larger sized ones is placed for permanent use, it must have made five strokes; and before a new type is accepted as having merit, one of the type must have made 500 strokes with safety. The initial pressures are very high. I do not know what the range is, but think that 40,000 pounds to the square inch is at present considered too low for the best practice.

There are many people in the world who think that the world would have been a better place than it is now if gas engines of this type had never been known. However that may be, it cannot be doubted that millions of them have been made, and it is hard to find a man or boy anywhere in the civilized world who does not own at least one of them. Some people do not think of pistols, revolvers, guns, cannon, mortars, howitzers and all the rest of such machinery as being gas engines, even after having seen the newspapers mention them as "engines of destruction," "death-dealing engines of war," etc., while they are in some ways at the head of all the classes.

POWER OF THE ENGINES

I have made some calculations as to the power of one of these gas engines of 12-inch bore, a 1000-pound piston, and a piston speed of 3000 feet a second. If my figuring is correct, which I have reason to believe it is not, that engine would exert 2700 horse-power if kept in continuous operation making a stroke every 90 seconds, and the greatest unobstructed travel of the piston during that interval of time would be 140,000 feet, or something over 26½ miles. As the piston speed at the early part of the stroke is 3000 feet and it takes 93 seconds to go the 26 miles, it can be seen that the motion is not uniform. For the work it is kept in readiness to do, that is not a very serious objection. If anyone should, after reading this, be tempted to use such a gas engine for generating electricity or doing other commercial work, I would advise him to first invent and test some simple form of governor; and he should remember that 2 per cent. is now talked as being a fair range of variation for gas engines of less energetic type.

The high initial pressure obtained and the necessity of keeping down the weight make it necessary to use the very best of material, and the mechanical engineer who does the designing has many very interesting and intricate conditions to meet. If you will take a small hand engine and, pointing it into space, have it make a stroke and note the reaction due to the action of the piston, you can clearly perceive the jar in your hand and arm, and, remembering the old adage, that "action and reaction are equal and in opposite directions," you can, perhaps, form some conception of the force that has to be overcome in the foundations of one of these 12-inch "monsters."

PRECAUTIONS IN TESTING

When one of them is put on the testing block ready for testing and everything is in readiness for the first stroke, most people who "know things" about such machines like to be in a safe place. A huge block of concrete is placed conveniently in the rear so that everybody who has to be there can have shelter in case the cylinder is not strong enough to withstand the pressure. If observation were absolutely necessary, a camera would be a good thing with which to make it.

PECULIARITIES OF CONSTRUCTION

In looking over the details, it will be noticed that the cylinder head is of peculiar construction. As it has to be handled very quickly when work is being done, there is no time to bolt it and it is screwed in. To withstand the pressure a very strong screw has to be used, but as time is precious, the screw is so made that it can be put in and only part of a turn is needed to tighten it. This is accomplished by cutting away part of the thread in the cylinder, and in the cylinder head. The tightening is done by means of a crank and gearing. A very peculiar packing is used that is set out by the force of the explosion.

I cannot go into all of the interesting details of these gas engines. The indicator is used on them and must tell many things just as it does on other styles and on the steam engines, but I have never had any experience with it there.

While I hope that my Uncle Sam will never get enough real work to give his numerous gas engines a test for endurance, yet I want him to always have the best ones to be found anywhere, for, unlike the work that the rest of us do, the better prepared he is to do an artistic and first-class job the less apt he is to get to do it.

Application of the Ward-Leonard Multiple-voltage System to Equalize the Load on the Line

The use of a 15-ton fly-wheel to equalize the demands for power on the main power supply, which fly-wheel has no positive mechanical connection with the point where the power is used, is a feature of an application of the Ward-Leonard multiple-voltage system of variable speed control, at the Zollern II colliery in Germany. It was described in a paper read before the British Institute of Electrical Engineers.

The hoisting drum of the mine is driven by two direct-current motors, the field strength of which is maintained constant, and the armatures of which are electrically connected to the armature of a generator, the electromotive force of which may be varied at will by varying the field strength. This generator is driven by a motor taking current from the line, and on the shaft is mounted the steel fly-wheel running at a peripheral speed of 14,000 feet per minute. The whole of the starting, stopping, speed regulation and reversing is done by one switch, which operates a resistance placed in the shunt-field circuit of the generator of the motor-generator set. The effectiveness of the motor-generator set in preventing fluctuations is shown by tests from which it appears that the tremendous rush of current from the line, which would be ordinarily required when the winding drum is started, is done away with; and during retardation, the energy which would be otherwise wasted by friction in braking is instead returned to the motor-generator from the winding motors and is employed in accelerating the motion of the fly-wheel. The hoisting motors took 1500 amperes at starting, and 1000 amperes after reaching full speed, whereas the motor of the motor-generator set took from the line 100 amperes while the drum was being started, and 450 when it had reached full speed.

A Foundry Coke and Sand Distributing and Storage System

EDITORIAL CORRESPONDENCE

The accompanying illustrations show a very convenient coke and sand distributing and storage system which is in use at the works of the John Bertram & Sons Company, of Dundas, Ontario, Canada.

The half tone, Fig. 1, shows the charging floor of the foundry on which the bins are placed, the photograph having been taken, however, before the bins had been built, thus showing the arrangement of the machinery as it could not be shown were the bins in place. The elevator boot appears at the extreme right with two spouts

FIG. 1. COKE AND SAND ELEVATOR AND CONVEYER

of which the one in the foreground delivers the coke directly to the bins as indicated by the small pile on the floor. The other or sand spout delivers the sand to a conveyer which carries it along horizontally until an opening is reached through which it drops into its bin. Each bin has, of course, such an opening with an appropriate shutter over it and by opening the proper shutter and closing the others the sand may be distributed to the bins as desired.

Fig. 2 shows the arrangement in plan, elevation and section, the elevator being located at *a a* and the conveyer at *b b*. The plan and cross section show the arrangement of the foot of the elevator boot and the location of the spur of track by which the material is brought to the foundry.

F. A. H.

Notes and Comments from England —Why Workmen Prefer Some Shops to Others—Conditions in Textile and Other Trades —How Correspondence and Evening Schools are Regarded Abroad

BY JAMES VOSE

Your remarks at page 490, Vol. 29, Part 2, on "Choice of Men and Choice of Shops," touch on a subject which is none the worse for occasional ventilation. Undoubtedly, the factors of reasonably modern sanitary conveniences, light, location, decent administrative methods, and steadiness of employment receive more consideration from workmen than is sometimes imagined.

WORKMEN DESIRE A SQUARE DEAL

At such times as the present workmen have some amount of choice, and the concerns which have never troubled about such details as above, are apt—as regards the class of men to be found in their shops—to get badly left when ordinary industrial conditions reappear. Much in the way of deficiencies in workshop comforts and conveniences will be forgiven by men if a "square deal" may always be relied on. Hysterical methods of attempting to attract men by offering rates distinctly higher than those generally ruling, followed by drastic reductions in number and remuneration of the working force so soon as slackening down of orders is experienced, inspire no respect on the part of workmen when, individually or in combination, estimating the acumen of the management.

A CONTEMPTIBLE FOREMAN

The incident related in your article has its counterpart in this city in the case of a comparatively small though scarcely negligible machine shop. For years the managers and foremen of other shops in the district were familiar with applications for employment from browbeaten men and boys, either ignominiously "fired" on frivolous pretexts or goaded to voluntary retirement by an ill-conditioned foreman, who had somehow hypnotized his employers into an almost incredible belief in his powers of management. Eventually, the paucity of applications for employment from respectable and efficient help became so marked that investigation ensued, promptly followed by the foreman in question being placed on the unattached list.

AN UNDESIRABLE REPUTATION

The mischief had, however, become so far-reaching that for a week or two, in order to induce applications for employment, the concern found it necessary to insert an advertisement in the local newspapers to the effect that "Messrs. ——— beg to announce that they have changed their foreman." Though such pronounced examples are comparatively rare, it would pay many a concern to quietly investigate working conditions in their shops when the output and profits become gradually unsatisfactory and complaints from customers increase.

THE MACHINERY SALESMAN

The papers referred to at page 491, as read at the Detroit meeting of the National Supply and Machinery Dealers' Association, in which the increasing number of salesmen required to effect sales was mentioned, suggest to my mind inquiry as to the present function and handling of the machinery salesman. He appears sometimes to be considered in the light of an aggravated specimen of the "non-producer," the justification for whose existence is difficult to establish to the satisfaction of some employers. When business is brisk it appears almost superfluous to employ him. When, and because of the fact that, business is dull, strong doubts as to whether financial returns justify his retention are often engendered.

UTILIZING THE SALESMAN'S TIME TO ADVANTAGE

During times like the present the traveling salesman often employs a good share of his time in calming, so far as possible, the natural irritability of customers who await overdue machines. Might not a portion of such periods be employed by mutual understanding, in placing on record for handy reference all the complaints and difficulties met with on his rounds, with a view to their rectification or obviation? Such a time is also appropriate for contributing to the data necessitated by the compilation or revision of live, attractive and well-arranged catalogs. Such utilization of the experience of travelers would often pay quite as well as their more usual and immediate activities.

OLD-FASHIONED METHODS IN STEEL PLANTS

The editorial at page 520, advocating greater refinement in the methods employed in tool-steel manufacturing plants, to match the care taken by progressive users in after treatment, is in order. I have noticed in a works—which it must be admitted turns out, on the average, a first-class carbon steel—that the selection of the stock of carbonized charcoal iron for final melting into ingots was performed by a patriarchal workman who, by only the appearance of the fracture of the pieces of stock, decided to which class of steel they should be assigned.

IMPROVEMENTS UNDER WAY

This plan evidently worked out pretty well on the whole, but one wondered if another slightly younger patriarch was kept in reserve in case of accident to or superannuation of, the original one. However, I am in a position to state definitely that, in quite a number of works over here, earnest attention is being paid to the study of the structure and behavior of tool steel under different conditions; and the monetary expenditure necessary is ungrudgingly sanctioned, so that the industry is likely to develop still further in its old environment.

WORKMENS' WIVES IN FACTORIES

Touching on the question, also mentioned at page 490, as to whether the wives of workmen shall go into factories and shops, the subject is much discussed in Lancashire in connection with the increased attention being bestowed on the infantile death rate. The consensus of opinion is that, as you remark, the system tends to the neglect of home-making duties, though it is really wonderful how many comfortable homes exist under the circumstances in the textile districts where this system is principally in vogue.

THE RESULT IN THE WEAVING TRADE

The reason for the prevalence of such conditions is that many branches of weaving are capable of being performed practically equally well by either male or female labor, and payment for the work is, as usual in such cases, probably less than would be the case if men only could be employed. Consequently the combined wages of husband and wife are often required for some years in order to establish the home and make some provision for a rainy day. One bad result is that a few lazy scamps are thus in a position to practically compel their wives to act as the breadwinners, while they themselves skulk in saloons or at street corners.

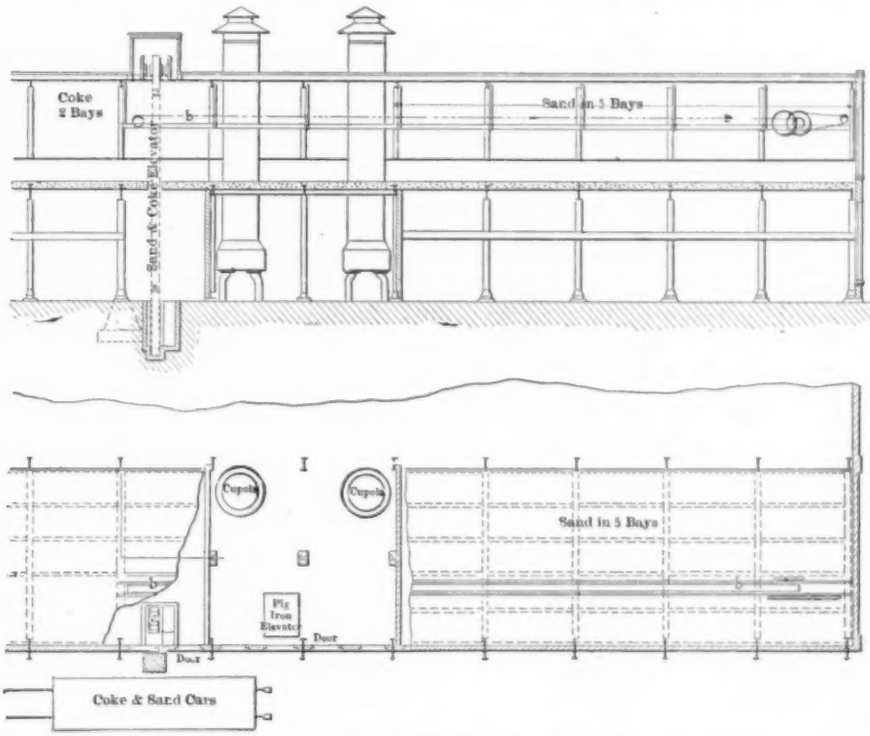
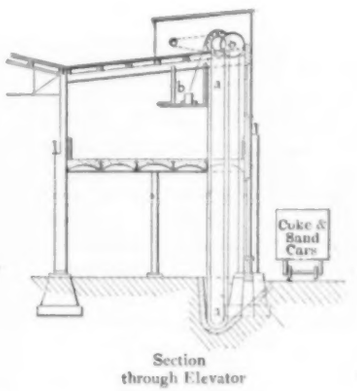


FIG. 2. COKE AND SAND DISTRIBUTING AND CONVEYING SYSTEM



Section through Elevator

GREAT DEMAND FOR HELP IN COTTON MILLS

At present the services of every possible worker in the cotton branches of the textile industry are called for, and harassed managers are, in effect, begging reformers to stay their hand for the moment. One feature of this business is that in the weaving trade men and women are paid at the same rate. As you remark, the advocacy by a professor of political economy of the idea of wives of American workmen—whose wages have often been quoted as the world's high-water mark—needing to supplement the domestic income by outside work is discreditable to the science of political economy as taught in the States.

CORRESPONDENCE SCHOOLS

The anniversary of the founding of the International Correspondence Schools calls attention to the merits of the plan. Over here, owing to more easily negotiable distances between evening technical or science schools, there is perhaps not the same scope as in the States for its development, but there appears no reason why the correspondence plan should not be utilized to a considerable extent by the principal technical institutions. I have often heard the text books of the International Schools spoken of appreciatively as presenting a well thought out sequence

of subjects and matter, and what I have seen of them confirms such a view.

A CRITICISM

One thing which might perhaps be criticized, in connection with the methods of drawing attention to the work of these institutions, is the special emphasis placed on the increased earning powers of students entering the courses. It is of course likely that something in such a direction will accrue, but on this side, experience gained in actual contact with any given industry carries much more weight than any scholastic success, with those having decent positions at disposal. It would perhaps be as well occasionally to impress on students that the instruction given is principally valuable as supplementary to their practical work; and that influence, personality, administrative knowledge, and opportunity are important factors in what is called success.

APPRENTICES AND EVENING CLASSES

To judge by some advertisements, anyone, no matter what his present calling, may easily be converted into an "electrical engineer" at a lucrative salary. Few positions are gained that way in this country. It must be conceded, though, that the fact of small additions being made by a few concerns over here to the wages of apprentices that steadily attend evening science classes has more than doubled the number of students in several English towns. This fact demonstrates that parents who were immovable when the benefits of mental culture only were chiefly to be anticipated, will often eagerly coöperate with educational authorities when cash is to be seen as a direct result of study.

Manchester, England.

Is This the Oldest Machinist Apprentice?

We have heard of machinists who retired from the trade to live on farms which they had acquired, but here is a case where, if the item be true, these conditions were exactly reversed:

Lockport, N. Y., January 3—Becoming tired of "sitting around," George H. Cooper, a wealthy retired farmer, 65 years old, has just begun to learn the trade of machinist. He says he doesn't need the money, but he cannot endure being idle.—*New York Journal.*

Mr. Cooper has shown good judgment in selecting an interesting occupation, among the devotees of which many amateurs are enlisted; but we doubt if there are many who, at his age, would go about taking up the pursuit in such a thorough manner, assuming that the meaning of the despatch is that he has entered upon an apprenticeship.

It is stated that the proposed New York Behr monorailroad cars will be constructed of an alloy of aluminum and magnesium.

IMPROVED TRANSMISSION DYNAMOMETER*

BY W. F. DURAND

The importance to the engineer of instruments and apparatus for the measurement of engineering quantities will perhaps serve as an excuse for bringing to the attention of the members of the society the form of dynamometer which is the subject of the present paper.

At different times during the past eight or nine years the author has had occasion to use a transmission dynamometer in connection with certain investigations on the action of screw propellers. For this purpose a special form of rope or round-belt dynamometer was designed and constructed which rendered excellent service. Forms of this dynamometer have been described in other engineering publications. This very considerable experience with one type of service exposed the less satisfactory features of this form of dynamometer, and in the endeavor to produce a perfected apparatus based on such experience, the design described herein was developed. See Figs. 1, 2, 3 and 4.

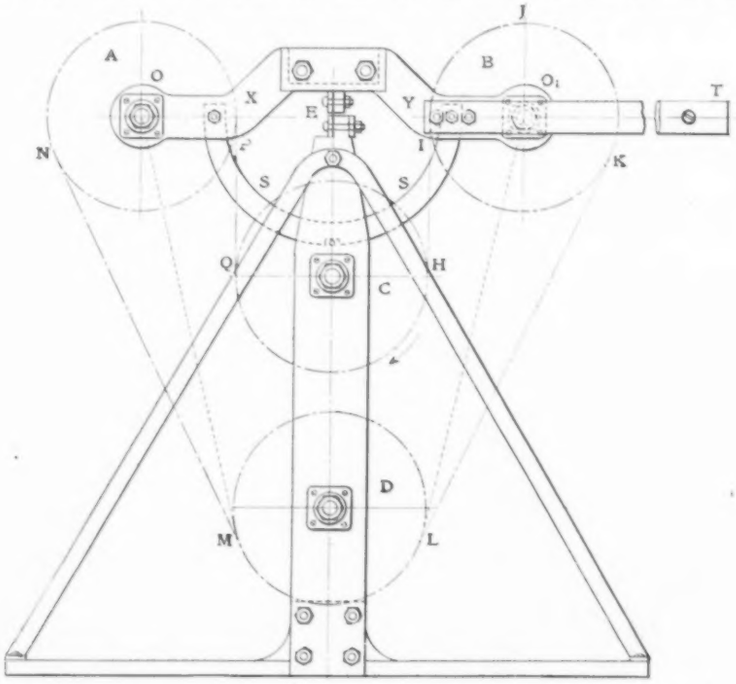


FIG. 1. SIDE ELEVATION OF DYNAMOMETER

In general the conditions imposed were as follows:

(a) To reduce internal friction to a minimum.

(b) To eliminate belt slip or creep under heavy loads.

(c) To provide an apparatus of maximum capacity for given weight of material, and, therefore, of the maximum degree of portability.

(d) To provide for the measurement of turning moment either by spring balance, by beam scale weighing, or by hydraulic step and pressure gage.

A and *B* are two sprocket wheels mounted on a frame *X Y* which is carried at *E* by a steel-spring support, after the manner of the well known Emery steel-plate knife-edge. This is frictionless, and for small movements of the frame the bending stress developed is infinitely small in comparison with the other forces in play. As shown at *S S*, semi-circular plates of steel fitted with a slot are carried by the frame, either side of which is held fast to the standard by a pin, while the frame oscillates through its permitted range of motion of about one-fourth inch at a distance of ten inches from the center of support. This permits perfect freedom of motion within this range, but prevents movement beyond to such an extent as to develop any sensible force within the steel-spring supports.

The sprockets *C* and *D* are similar in form and size to *A* and *B* and are mounted on standards attached to the base. All sprockets are mounted on ball bearings in order to reduce friction to the minimum. Around these wheels is led a chain, the dimensions being so adjusted that with the proper length of spring for bearing at *E*, the chain throughout its length will run with the proper amount of slack for smooth and steady operation.

The similarity between this form of dynamometer and the Tatham form will be readily noted. The present type may,

*A paper read at the New York meeting of the American Society of Mechanical Engineers.

in effect, be considered as a development of the six-equal-wheel form by the elimination of the two lower wheels and the substitution of chain for belt drive.

The shafts which carry the sprockets C and D are extended, carrying pulley wheels at F and G, Fig. 2, and also universal joint couplings for direct connection to a driver or follower. The power can be put in at C, and taken out at D or *vice versa*, and on either side of the dynamometer as desired. If the power passes through from C to D, and C turns as indicated by the arrow, it is readily seen that the tight side of the chain will be from H around through $I\ J\ K\ L\ M$, and the loose side from M, through $N\ P$

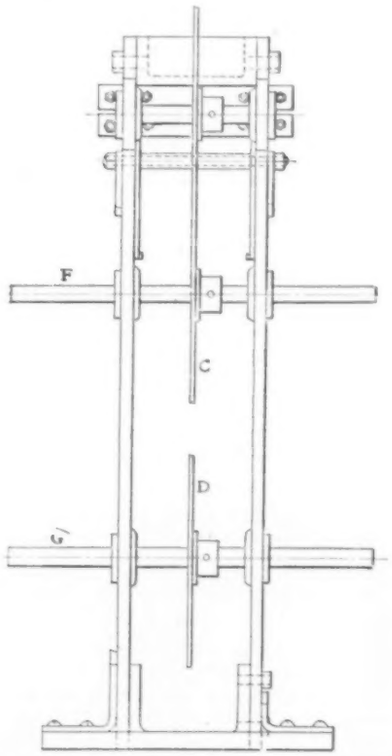


FIG. 2. END ELEVATION OF DYNAMOMETER

to Q. Thus $H\ I$ and $K\ L$ will, under the higher or driving tension T_1, be equal on both sides except for the small friction of the ball bearing on which B turns. Likewise, $M\ N$ and $P\ Q$ will, under the same loose or following tension T_2, be the same on both sides except for the friction of the ball bearing on which A runs.

Disregarding these small frictional resistances, the two tensions T_1 will have the resultant $2T_1 \cos.\theta$ directed along the line $O_1 L$, while the two tensions T_2 will have the resultant $2T_2 \cos.\theta$ directed along $O\ M$. The components of these forces perpendicular to the line $O\ O_1$ will be in each case $2T_1 \cos.^2\theta$ and $2T_2 \cos.^2\theta$. Denoting the distance $O_1 E$ by a, we have for the net turning moment about E:

$$M_1 = 2a\,(T_1 - T_2)\cos.^2\theta.$$

Again denoting by r the pitch-line radius of the sprockets, we have for the power taken off at D the turning moment:

$$M_2 = r\,(T_1 - T_2).$$

Hence

$$M_2 = \frac{M_1\, r}{2a\ \cos.^2\theta}$$

and

$$\text{work per } mi. = 2\pi N M_2 = \frac{\pi N M_1}{a\ \cos.^2\theta}.$$

Obviously the two tensions T_1 on the

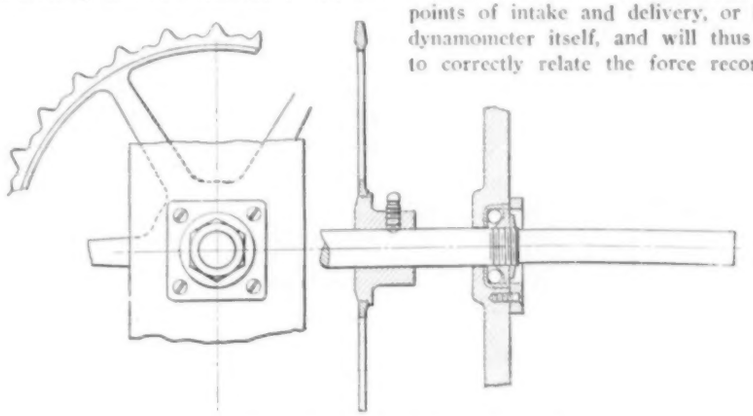


FIG. 3. DETAILS OF DYNAMOMETER

right, acting against the two tensions T_2 on the left, will determine a moment tending to depress the end T of a lever attached to the frame $X\ Y$. If we denote $E\ T$ by h and the force at T required to balance the moment by F we shall have:

$$M_1 = Fh, \text{ or}$$

$$\text{work per } mi. = \frac{\pi N F r h}{a\ \cos.^2\theta}$$

By careful measurement of the dimensions of the dynamometer the relation between the power transmitted and the observed values of N and F can be determined. As in all cases involving the use of such apparatus, however, it will be more satisfactory to calibrate directly by mounting a friction brake on a belt wheel attached to the delivery shaft and noting the relation between brake readings and the values of the force F. Such a calibration will of course serve to eliminate all friction between the points of intake and delivery, or in the dynamometer itself, and will thus serve to correctly relate the force records as measured by F with the actual power delivered.

In the case of the dynamometer under present notice the relation in question was determined by both methods—measurement and computation, and by experimental calibration. The difference should then be an indication of the amount of power absorbed by the friction of the apparatus. The tests indicated but slight friction in the chain and bearings, which might have been expected from the character of the design and construction.

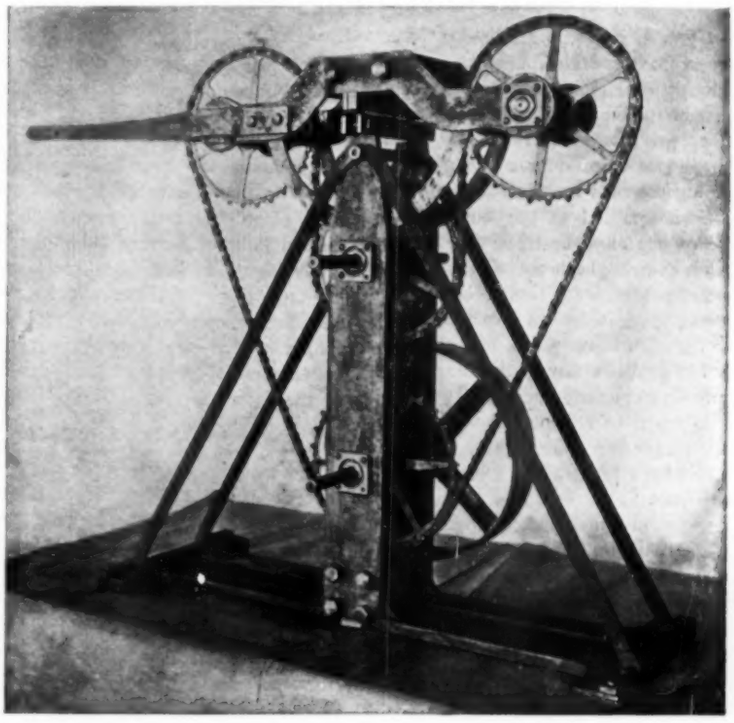


FIG. 4. DURAND'S TRANSMISSION DYNAMOMETER

The chief dimensions of the dynamom-

eter shown in the figures are as follows:

Diameter of sprocket wheels.....9 in.
Diameter of shafts.....¾ in.
Size of chain.....3/10 in. wide
Hight over all.....30 in.
Width of base.....12 in.
Length of base.....30 in.

The capacity of the dynamometer as constructed was intended to run to some 5 or 6 horse-power. Certain experiments requiring somewhat more power presented themselves, however, and the dynamometer was successfully used up to about 12 horse-power; but this is more than was intended and is beyond the proper limit for sprockets, chain, and bearings of these dimensions.

In terms of revolutions no trouble was experienced in running the dynamometer up to 800 or 900 revolutions per minute, speeds which would with difficulty be realized with a rope- or belt-driven dynamometer.

Foreign Markets for American Machinery—Oil Engines Abroad

It would be well for American makers of oil engines to pay attention to the Australian market, where considerable opportunities for trade are opening up. Hitherto oil engines have not been very extensively used throughout the Commonwealth.

GAS AND STEAM ENGINES

The comparative cheapness of coal in some localities has led to the popularity of the gas engine. But the bulk of the coal supply is obtained from New South Wales, and it is of course cheaper near the mining districts than in towns far distant. This has led to the limitation of the use of gas engines, while the demand for steam engines, both portable and fixed, has steadily increased, timber being generally employed as fuel in localities where coal is dear. Of late years, however, this supply has shown a rather alarming depletion and consequently increased attention has been given to oil engines as a substitute for steam and gas engines.

PROGRESS OF THE OIL ENGINE

Two causes have operated to keep the oil engine in the background. First, faulty construction, and secondly, the inferior quality of the oil available. Latterly, however, great improvements have been made in the production of oil for the Australian market, and at the same time the price has been lowered to such an extent that in many places it is considerably cheaper than coal or timber. At the last show held by the Royal Agricultural Society in Sidney, N. S. W., the largest of its kind in the Commonwealth, it was certainly significant that oil had replaced steam and gas to a greater extent than on any previous occasion.

OIL ENGINES AT AN EXPOSITION

All the oil engines there shown were either of British or Australian make. It was also noticeable that although several of the engines could be worked with crude petroleum, this was not generally regarded as a recommendation. A good part of the machinery in the motion section of the exposition was worked by oil, the smoothness of the running and the comparative absence of noise being a marked feature of the display. At several of the stands, displays of sheep-shearing with machinery worked by oil power were given, and it is stated that this was followed by quite extensive orders from the pastoral districts.

GENERAL USE OF SUCH ENGINES PREDICTED

It has been the same in the other States, and there is every probability that the use of shearing machinery worked by oil power will become general within the next few years. The oil engines are also found useful for many other purposes in which cheap and efficient motive power is required. They have been used for pumping in many cases, and have been found more serviceable than many of the windmills. It is also a noteworthy fact that on several pastoral properties coal is quite unobtainable except at a prohibitive cost, while the supply of timber, and very frequently of water, is limited. So we see that all the facts point to the greater use of the oil engine.

APPLICATION IN THE MINING FIELDS

This also applies to the mining districts, where oil power is steadily making progress, more particularly on small claims where steam is found too costly. There is a very large field in this direction for manufacturers having a knowledge of mining requirements. Beyond a certain limit of power, steam must necessarily be used; but there are very many openings for the oil engine as a substitute for manual labor, and especially on claims which are being prospected or tested for settlement purposes it is coming to the fore.

OTHER OPPORTUNITIES

It was pointed out at the Sidney show that the work of clearing and preparing for cultivation could be largely facilitated by the use of oil engines capable of being moved from place to place. In the workshop, where only a limited amount of power is required, oil has almost completely displaced gas in the Commonwealth; it is regarded as safer, more under control, and more economical. There is plenty of room for improvement in the oil engine of today, particularly in the small types. In large printing and other industrial establishments their employment as auxiliaries to gas and steam engines is steadily increasing, with equally favorable results.

MARINE APPLICATION

Nor is their work confined to land purposes, there being a growing demand for small engines for launches and boats; while it is stated that oil power is employed on over 2000 harbor and river boats and launches in the Commonwealth.

From all these facts you will readily see that there are really solid grounds for believing in the Australian market as a buyer of all kinds of oil engines, provided that they be so constructed as to be suited to the local wants of the people, and of thoroughly reliable workmanship and design. It will certainly well repay American makers to study the matter, as it is a trade that must eventually assume very large proportions.

POPULARITY OF OIL ENGINES IN INDIA

In British India also these engines are becoming every day more popular, and especially in Bengal, not only on account of the advantages which the system offers, but also owing to the proximity of Burmah, where the fuel can be readily obtained. The demand is not only for small engines, but also for those exceeding 200 horse-power. At Madras, the Buckingham Mills have installed a "Diesel" engine of 225 horse-power which is reported by the purchaser to be giving entire satisfaction. The gold mines of Nizam will soon be employing a 200 horse-power engine, and the Madras Government has quite lately placed orders for light engines at 160 horse-power each.

IRRIGATION IN THE HOLY LAND

In Palestine this type of engine has been steadily growing in favor for some years past, being used for irrigation work in the vineyards. There is no doubt that it is a form of power destined to take a very prominent place, and to become a very remunerative specialty to the manufacturers securing the trade.

London, Eng. F. C. C.

A recent British express locomotive has driving axles with concave journals 7¾ inches diameter at the center, 9¼ inches diameter at the ends and 12 inches long. The concavity amounts to 1½ inches or ¾ inch on a side. Concave journals are used extensively in Germany and other European countries but have never been adopted by any railroad in the United States. The advantage gained by their use is principally due to the shape which prevents the concentration of the load at a sharp fillet, which so often results in the fracture of the axle. The convex bearing has a tendency to maintain a central application of the load, wears more evenly and is not so liable to become overheated by excessive pressure at one point. A further advantage is the prevention of end thrust, with consequent collar wear, which is the frequent cause of hot boxes and requires renewal of bearings before they have made a proper mileage.—*Railway Age.*

CORRESPONDENCE

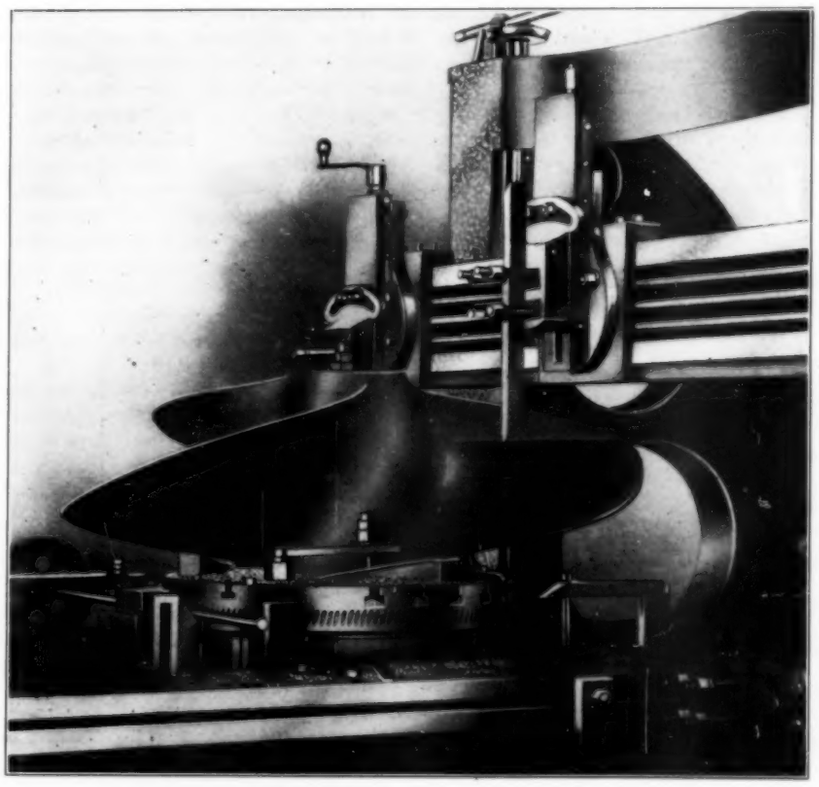
Discussing Phases of Machine Design and Construction

Planing Propellers

The article by E. R. Plaisted at page 677 (in which he points out the difference between formulas and facts in shop practice) appeal to me, for I have found it necessary to leave "the beaten track, and cut across lots." It also tempts me to relate the latest thing in that line.

The advent of the marine turbine in the works where I am employed gave us all something of a jar, and after the superintendent and the foreman had taken a trip to Europe to obtain points the crew naturally got a little shaking up. The methods employed in the Parsons Works were, of course, vastly different from our down-east Yankee ways, but in one thing they still had a little to learn. The propellers used with the Parsons marine steam turbine are radically different from anything we had ever used, being relatively small in diameter, with extremely broad blades, and working at very high speed, requiring a true face and perfect pitch. Our friends on the other side content themselves with chipping and filing the faces of the blades to gages, making thereby an obviously expensive and somewhat imperfect job of them.

Having acquired a reputation in the shop for what is locally known as "rigging up," I one day received an invitation from the boss to slip over to the pattern shop and see if there was any way to plane the propellers on which the patternmakers were then at work. Accordingly, I slipped, and found upon investigation that the propellers in question were a true screw with the lines of the face at right angles to center line of the shaft. The boss was duly informed that they could be planed, whereupon permission was given to go ahead, and it was up to me to make good. Scouring around the slotters, I found one with a rotary platen, four feet in diameter with 194 worm teeth on the circumference, operated by a double worm. This was borrowed for the occasion and placed on parallels on the planer. A plate to fit the counter bore in the hub of the propeller was fitted to the center of the slotter platen to hold the propeller in position. This plate had a raised boss in the center, in which a ⅞ twelve-thread hole was tapped, and in this a long stud was screwed with its upper end turned true to center and pointed. From this point as a guide the center was transferred to a target on the rear of the planer platen and this was marked with a center punch for future reference. Then the pointed stud was removed, and one with a thread at the top was substituted to take a strap across the hub of the propeller for clamping it to the rotary platen. When the actual cutting point of the tool is set on the center line of the work as shown on the target, and the planer head is firmly locked to the rail, the propeller and tool are in position. The vertical feed on the planer was obtained from a single-thread screw, four threads to the inch, operated by a ratchet of 41 teeth, giving a mean feed of 1/164 of an inch. For rotating the propeller a ratchet was made with 82 teeth, using three and operating a spur wheel of 97 teeth, which in turn drove the worm on the rotary platen by engaging a wheel of 108 teeth, keyed to the worm shaft. The rotary feed was operated by a double-ended lever secured to the ratchet, carrying a horizontal pin at each end, projecting at right angles to the travel of the planer and actuated by passing over a fixed cam secured to an angle iron fastened to the floor. To guard against the liability of the gain or loss of a tooth on the ratchet operating the rotary feed (which might easily occur from lost motion, or the tendency of the ratchet to act as a balance wheel after leaving the cam on the quick return of the planer) I cut in the face of the disk containing the ratchet radial grooves of V section, with a pitch a trifle greater than the required number of teeth in the ratchet. I then fixed to the end of the stud, carrying the ratchet and gear a stiff spring with a hardened V point, to latch in these grooves, thus locking the ratchet at each end of the stroke. The excess pitch of the grooves over the teeth served to compensate for lost motion, torsion, etc. All being in readiness, we proceeded with four teeth of vertical feed to plane the propellers. The accompanying illustration shows the finishing cut being taken on the last



PLANING THE BLADES OF A PROPELLER

blade of what I believe to be the first propeller ever planed.

J. C. TOURTILLOTTE.

Jig for Drilling Steam-pump Glands

Being a jig and tool designer I am naturally interested when I see a jig of any kind in your columns. The jig submitted by "Steam Pump" at page 816, Vol. 29, Part 2, strikes me as being an expensive design for the work it performs. If some of the shops I have struck in this country, that use interchangeable methods for every

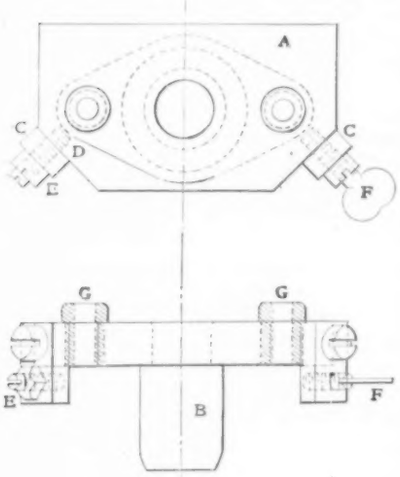


FIG. 1. A JIG FOR PUMP GLANDS

piece possible, were to adopt designs like this, their tool department would be a very expensive item. Why do jig designers love to cast jig bodies, when in many cases machine-steel stock would be considerably cheaper, and produce as good, if not better, results? The design I should turn out for the gland required by your contributor would be as shown in Fig. 1.

A is a machine-steel plate with the locating peg *B* riveted to it. B is to be a sliding fit in the bore of the gland. *C C* are machine-steel pieces, one with a locating screw *D*, and lock nut *E*, the other with a thumb-screw *F*. *G G* are the drill bushings.

Let the job rest on its own base, slip the peg in the bore, and locate the flange against the screw *D*, fastening the gland by screw *F*. If the rim of the flange is finished, a pin may be substituted for the screw *D*. In this case the pin would be driven in the main plate. If an objection were raised to resting the gland on its own base, and it was necessary to locate by the outside diameter of the gland, Fig. 2 would do the trick.

A is a machine-steel piece gashed out to receive the gland flange; *B* a piece screwed and doweled on the bottom, which is taken off after being bored with the body, the body bore is milled out and the piece *B* replaced. *C C* are machine-steel pieces, one with a locating screw *D* and lock nut *E*, the other with a thumb-screw *F*. *G G* are the drill bushings. Space is allowed between the pieces *C C* and the body *A* to clear the gland flange. Slip the gland into the recess and slide it down into the bore. Locate it by the flange against the screw *D*, fastening it by the screw *F*.

These jigs, I think, are not only cheaper, but quicker in handling and safer. In Fig. 1 the only parts requiring careful work are the positions of the peg *B* and the bushings *G G*, and in Fig. 2 the positions of the bore and the bushings *G G*.

Your contributor's jig is a leaf jig, which, at the best of times, are abominations. The style of leaf I do not consider at all practical. True, he has provided a centering arrangement, which means finishing the boss of the wing nut to fit the recess; but drillers who work with jigs are not, as a rule, the most intelligent of men, and you are likely to run across a man who would disregard the recess. You may say, "Well, if a man is fool enough to do that discharge him." Perhaps so, but before you catch him he may have scrapped a few dozen pieces for you. The chief aim in jig design is to make them so that any blithering idot may use them and not go wrong.

A cast-iron location is bad, especially when a sharp edge is likely to encounter it. I am afraid the locating bore shown would be pretty well used up after a short period, unless it received very careful handling, which a jig is not likely to get.

SYD. P.

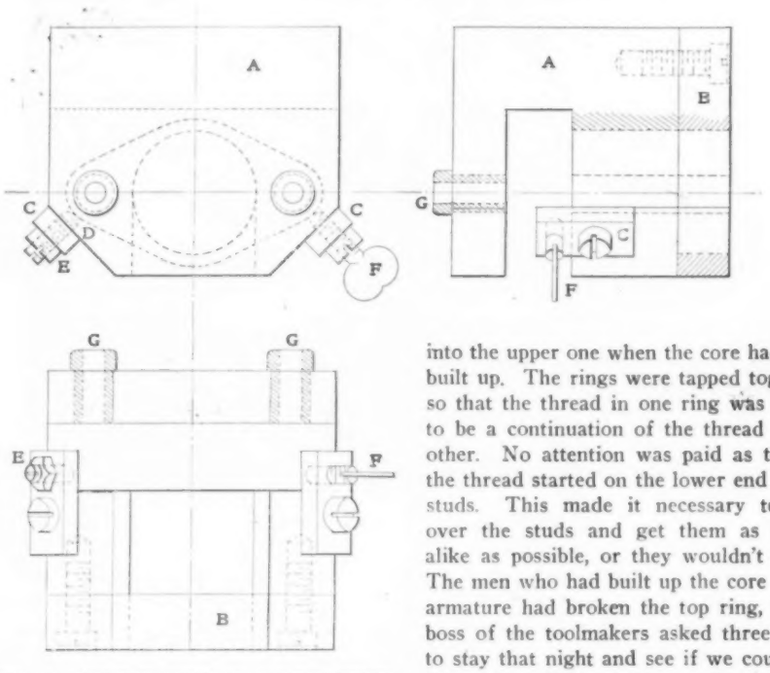


FIG. 2. ANOTHER FORM OF JIG FOR PUMP GLANDS

Lost Processes

In looking through a magazine the other day I ran across an article on lost treasures. It set me to thinking of the things of interest to mechanics, which, if they could be rediscovered, would mean dollars to the lucky man.

I had been at work several years when I ran across the first. Like most good things, it received but little thought at the time. A man had come to a sewing-machine factory in a city in Connecticut who claimed to be able to temper steel, such as they used there, so that it would cut the chilled iron found in some of the castings. Well, he made good. The tools he tempered would cut through the chill and hold their edge, at the same time being tough enough to stand considerable abuse.

Up to this point my information came from men who were working in the factory at the time. Of the following I speak from personal experience: I was given a screw-driver about ¾ inch square on the shank and 12 or 14 inches long, which had been tempered by this man. I had carried it for a couple of years, using it rather roughly at times, when I went to work for a concern that had started to build a direct-connected generator. Things didn't go as smoothly as expected and they were behind on their orders. On one order in particular there was a time limit, with a forfeit for each day over time in the contract. The order was for an 80-kilowatt generator, the armature of which measured about 5 feet across, having approximately 50 studs to hold it together. The studs were threaded on each end in the screw machine and were designed to screw into the lower ring and from there into the upper one when the core had been built up. The rings were tapped together, so that the thread in one ring was bound to be a continuation of the thread in the other. No attention was paid as to how the thread started on the lower end of the studs. This made it necessary to pick over the studs and get them as nearly alike as possible, or they wouldn't go in. The men who had built up the core of the armature had broken the top ring, so the boss of the toolmakers asked three of us to stay that night and see if we could get it together. We got the new ring in place, and about two-thirds of the studs in, when our troubles commenced. The studs had to go in, so we worked them back and forth, until all the screw-drivers on the job were broken, with the exception of mine. We were so tired by this time that we used but little judgment. The other

screw-drivers had been broken by putting the knee under the handle and a wrench on the shank. We continued this with mine until the driver could not be held in the slot. We then got a screw jack and placed under it, following up as the stud went in. Some of them still stuck. Getting a piece of pipe, we put it on the wrench, pushing until the driver showed a decided spiral. Of course there was only one end to this kind of work—we broke the screw-driver. By this time the factory had started for the day, so the blacksmith and boss toolmaker undertook to keep us in drivers until the remaining two or three studs were in. None of these went in any harder than those we had already driven with my screw-driver, but in doing it we broke eight or ten that they made.

Almost every toolmaker in the place tried to temper a screw-driver that would stand up as that one of mine did. The man who had tempered that one had died and his process with him. For a year or more, in my spare time, I tried to get something equal to his process; but, while I got results better than the average, I never got the results I was looking for. The man who can temper tools that can stand up as well as that screw-driver did will never have to scratch the bottom of his pockets for change.

Two oils, which chemists said could not be blended, were blended in a kitchen in New Haven, Conn., and a barrel of the mixture was sent to one of the arms companies of that place. The process would, if rediscovered, place the lucky person on easy street. Thinking they could get all they wanted, the men in the shop were not at all careful. But the discoverer died after having made only one barrel and his secret died with him. One of the men got hold of a couple of quarts and had it analyzed. He found out what the oils were, but was told there was no way of blending them. All mechanics know how hard a nurl is made. A stock drill moistened with this oil has drilled into a nurl that was so hard a file made no impression on it. The original discoverer intended it for drilling rifle barrels, but a use could be found for it in hundreds of ways. There was still a half pint of it left four years ago, so we may hear from it yet.

While working for a patent-leather concern one of the men was telling of the hard luck, as he called it, of a mechanic connected with the shop, who had discovered a compound, which, when applied to leather, would stand the cold without cracking. He had made up a few quarts and had applied some of it to a skin. He then put it to all the tests he could think of, as he had done several times before. It passed through all of them and (according to the leather man) was the best thing he had ever got hold of. Things went along all right until they tried to mix up the second lot. This was put through the same process as the first, but the stuff was worthless. After that they tried everything to find out what had dropped into the solution, to make it the success it was, but I have never heard that they found it.

Probably some of the readers of this will say that all of these processes belong more to the chemists than to the mechanics, and probably they do. But most mechanics at some point in their career have dabbled more or less with chemicals, following up some idea. Besides, mechanics discovered them first—why can't they rediscover them or find something just as good?

B. H.

Patterns for a Globe-valve Body

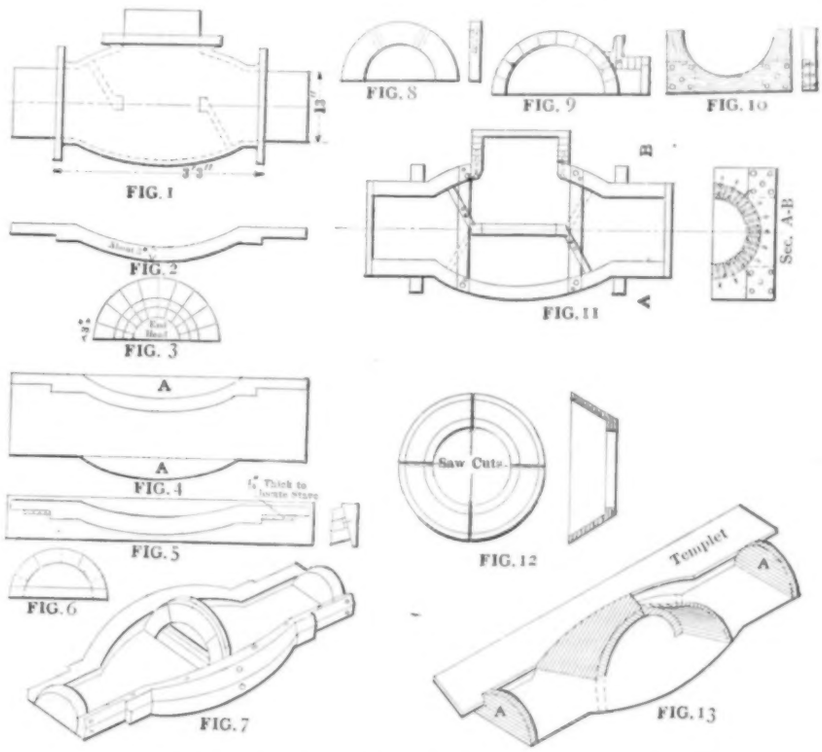
The following article and drawings describe the making of a pattern for a 13-inch U. S. navy standard composition globe-valve body.

Fig. 1 shows a view of the pattern with the valve seat drawn in dotted lines. We first lay out a full-size section lengthwise of the valve, then make a templet of the outside shape of the body, with the core prints on each end, three inches wide in the rough, Fig. 2. This is for the staves of which we build the body. Space off a circle of the largest diameter of the body according to the thickness of the material you are going to use (I prefer 3-inch) and see how many staves you need (see Fig. 3). Then lay them off as in Fig. 4, gluing the piece *A*, taken out of the first one, onto the opposite edge of the plank, thereby saving a considerable amount of material. Now, from the end view (Fig. 3) get the taper of the staves, and cut away part of the surplus stock on the circular saw, after which straighten one side on the jointer. Get out a taper piece two inches longer than the staves, and one-half inch wider, and have the taper the same as that of the staves. The piece shown in Fig. 5 is to lay the staves on when you run them through the planer, making them the right thickness and taper.

Get the end heads out of 2½-inch material, and saw to diameter taken from Fig. 2. The center head is so large that it is best to build it up in segments with a tie piece across the joint, as at Fig. 4. Set the heads up on the layout board, and fasten the staves on. You can also nail the staves to each other. The pattern will now look like Fig. 7.

After you get the body of the pattern built up and turned, get out the flanges, as shown in Fig. 8. This beats gluing the flanges up in courses of segments, because segments will part with use, no matter how carefully the joints are made, unless securely nailed. Fit the flanges to the body, and turn. Now build the neck of the pattern up of segments, nailing them well. Turn up and fit onto the body and screw from the inside, putting a leather fillet on the outside where the neck and body join. A section across the center of the pattern would now look like Fig. 9.

Now proceed to get the core-box out in the same manner as the pattern, that is, lay out the staves and plane them to thickness; then get out the heads of 2½-inch material, using three pieces for each



THE PATTERNS FOR A 13-INCH U. S. NAVY STANDARD GLOBE-VALVE BODY

head, half-lapping the joints, as in Fig. 10. If you were not careful in sawing the staves from the plank, it is a good plan to resaw them very close to the inside line, after planing to the taper, allowing 1/16 inch to be dressed out with a spokeshave after the staves are in place. Set up the heads, keeping them as close to the swell of the body as possible (see Fig. 11) and fasten the staves in place. Dress the core-box to size.

Build the valve seat out of segments and turn (Fig. 12). Cut the seat into four equal parts. Fasten two of these parts down on the layout. Then erect one semi-circular piece on each end of the layout, of the same diameter as that of the core prints, as *A*, Fig. 13. Get out a templet the same shape as the inside of the core-box to ride on half circles. Work the templet over pieces of the valve seat until it just clears. Take pieces up and set the other half of the valve seat to the opposite hand, as indicated by the dotted lines, Fig. 13. The parts of the valve seat are held in position in the core-box, while the core is being rammed, by two pieces about ¾x2 inches, doweled and screwed across the face of the box, and screwed to the valve seat, Fig. 11. Build the branch up in segments, finish out and then fit over the outside of the core-box and screw through from the inside, Fig. 11. Put the ends on the box and the job is complete.

For composition casting 3/16-inch shrinkage is allowed on the pattern and 1/10-inch on the diameters of the core.

This method of construction saves time and material in building, makes a light pattern and core-box for handling, and at the same time makes a very strong job.

CHAS. T. REYNER.

A New Way of Milling Cams

Seeing Dynamic's letter at page 613 on milling cams has prompted me to contribute to the subject, as I do not think his method covers as much ground as it might. Setting the index head vertically and using the vertical spindle attachment does not enable us to mill cams of very slight rise, nor even cams of more abrupt rise, unless we have the proper gears on hand. But, by the method here shown, we may mill cams of any rise with the gears regularly furnished with the milling machine.

With the head set vertically the lead of the cam would be the same as the lead for which the machine is geared, while with the head horizontal and the milling spindle also, a concentric arc, or rest, would be milled on the cam, regardless of how the machine was geared. By inclining the head and milling spindle, we can produce any lead on the cam less than that for which the machine is geared. The head being inclined brings the cam farther from the end of the table, and so does away with the extension shaft which seems to be a necessary feature with Dynamic's method when milling a plate cam.

The method of finding the inclination at which to set the index head is shown in Fig. 1, and is simply the solution of a plain right-angled triangle, in which the hypotenuse represents the lead of the machine, and one of the other sides represents the lead we wish to produce on the cam. By dividing the latter by the former we get the sine of the angle of inclination.

Take for illustration a plate cam having ⅛-inch rise in 300 degrees.

$$\frac{360}{300} \times \tfrac{1}{8} = 0.15,$$

which is the lead we want on the cam, while the slowest lead for which the B. & S. machine can be geared is 0.67

$$\frac{0.15}{0.67} = 0.224.$$

Consulting a table of sines, we find 0.224 comes pretty close to being the sine of 13 degrees, which is the angle at which to set the head; and if the milling spindle is also set at the same angle, the edge of the cam will be parallel with the shaft on which it is to run. Fig. 2 shows a milling machine set for this job.

When a cam has several lobes of different leads, we gear the machine up for a lead somewhat longer than the longest one called for in that cam, and then all the different lobes can be milled with the one setting of gears, by simply altering the inclination of head and milling spindle for each different lead on the cam.

If the diameter of the cam and the inclination of the head will admit, it is better to mill on the under side of the cam, as that brings the mill and table nearer together and thus increases rigidity, besides enabling us to easily see any lines that may be laid out on the flat face of the cam. Also the chips do not accumulate on the work.

The work is fed against the cutter by turning the index crank, and on coming back for another cut we turn the handle of milling-machine table. As a result the work will recede from the cutter before the cam blank commences to turn, owing to back lash in the gears, thus preventing the cutter from dragging over the work while running back.

In this way we use to advantage what is ordinarily considered a defect in machine construction.

The milling machine, when used as shown in Fig. 2, will be found to be more rigid than when the head is set in the vertical position, and the cams will work more smoothly on account of the shearing action of the cutter.

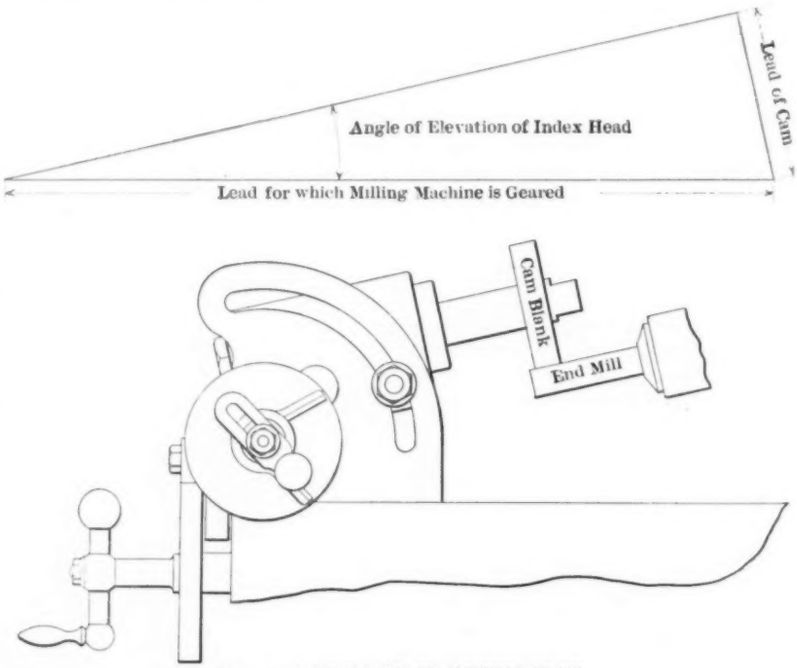


FIG. 2. A NEW WAY OF MILLING CAMS

One possible objection to the method here advocated is the necessity of using, in some cases, an end mill of extra length of tooth. In practice, an end mill ⅞ inch diameter and 3½ inches length of tooth is not unusual; but the results in both speed and quality will be found entirely satisfactory.

MILLING HAND.

The Shop Hare and Tortoise

When I was a boy I was deeply impressed with the story of the hare and the tortoise. I supposed at that time that I was different from other boys, because I simply could not keep at one job steadily. I had no objection to working, but I wanted to rush things, and then lay off

and rest. Since then I have noticed that this tendency is not entirely confined to myself.

I believe that the most nearly indispensable man that I ever had in the shop was, and is, a man who works to advantage only on a job which he knows no one else will or can touch; then he will work like a Trojan. Ordinarily, he just slouches along, and his work is only fair; but give him any job you want in a hurry, and rough or fine, dirty or clean, he will get it out when you want it. He won't average to do any more work than other men, but he is right there when an emergency job comes along; and the hare that can jump to a job in an emergency and save fifty men loafing an hour apiece can be a tortoise the rest of the time in my shop. If I say that I have kept this man working where my job was for twenty years, it may help to prove my sincerity in stating that I prefer the man that has more than one speed ahead, to the tortoise Of course, if you have a shop where everything is so systematized that your machine hands are automatons, then you set the speed-pace, and they have to keep it; but, even then, you have to have someone who will take a running jump at an emergency job rather than one who will crawl painfully over it.

Did you ever feel that there was something ahead of you that you must do, without realizing any compelling power? I feel it every time I see a mountain. Now I have climbed mountains enough to realize that the best view is a long way from the top, and that it is a total waste of energy to climb clear up; but still I cannot rest till I have climbed a mountain, if I get in sight of it. That same impelling force takes men through jobs which they realize that they are not paid to do. A man of that sort would have gone down under W. Osborne's dirty planer in his best Sunday-go-to-meeting clothes. It is the same force that impels men to risk their lives seeking the North Pole. If it is used to carry one over a disagreeable or a hard job, it is no less to his credit than if he were the intrepid explorer. It is this spirit that moves the world along. The man who sits down to carefully calculate how he may get the best of the world always finds himself underneath his job and badly crushed. The man whose main idea is to do something, and do it with all his might, inevitably achieves something, and with that something may come money and fame. Don't be too sure that I am wrong. Don't say that you have tried and failed, till you look yourself over carefully, and see if what you really tried was to do something. Most likely it was to do somebody—to get rich at someone else's loss, or to live on your wits, as they say.

I have hobnobbed with quite a few men who are rated as successful, and this has struck me most of all, even with men whose methods have been criticized: that the money and the fame were only incidental, and that the real thing to them was the conquering of some obstacle that seemed to be in their way—the climbing of the mountain that stood out in their sight as an invitation and a challenge.

ENTROPY.

A Blanking Die and Forming Tool for a Clip

I should like to offer a few suggestions regarding the forming tools shown at page 639, Vol. 29, Part 2, by W. H. F. The die as shown appears to be made solid, with the center bored out and the slots machined. The drilling of some of the holes for the pivots on which the pawls work would entail considerable care and trouble to get them exactly in their correct position.

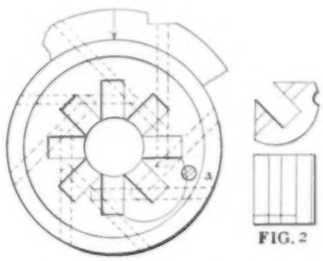


FIG. 2

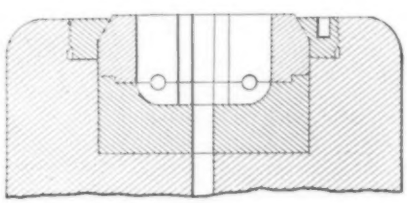


FIG. 1. THE FORMING DIE

The accompanying sketches show another method of making the die; here it is represented as circular, in two pieces, and arranged to fit a standard bolster. The two sections are recessed together and a screw *a* put in. After the halves are fitted in this way, the center hole is bored through both and the slots for the pawls laid out. The hight for the pivots is marked off, and a machine steel collar made a little higher than the lower half of the die, to serve as a jig to drill the pivot holes. A part of it is shown in position in the plan. A mark is made on the side of the die at the center of each of the eight slots. One of the pivot holes having been marked off, the collar is marked with an arrow to coincide with the mark on the die for that position. The hole is now drilled to the required depth—not right through as shown by W. H. F.—the collar is moved round to the next mark and so on till eight holes have been drilled.

By making the die in two pieces as shown, the assembling is very much simplified, and the necessity of making a cap as shown in Fig. 2 is obviated and also of getting out the hole in the die to correspond.

By making the die from round stock both time and material are saved.

B——, England. CYCLO.

Do Scientific Hardening Methods Produce Better Results than Practical Judgment?

Your editorial regarding steel and its treatment in steel works, at page 520, brings to mind an example of the disappointing results sometimes met with in adopting a more scientific and supposedly better method in place of the old methods, which brought into play a certain degree of skill to get results.

It also gives rise to the belief that the scientific engineers in the profession would be oftentimes better employed in trying to get a better price for their brains and products, instead of sitting up nights thinking of ways to displace skill. I refer to scientific methods used in the hardening of tool steel.

THE OLD METHOD

The company used enough tool-steel pieces in its manufacture to keep a man and two gas furnaces going continuously. The man employed to do this work heated everything entirely by his eye and judgment and the results obtained were distinctly good.

There was not one piece in a thousand which ever gave any trouble from softness or cracks, the work was turned out rapidly and on time, and hurry orders could be executed at once.

THE TEMPTER

Unfortunately for him the proprietor attended some society meetings, heard some papers read, saw some temperature diagrams and records and learned that all these years he had been doing wrong and following a haphazard and old-fashioned system not in accord with modern practice and utterly unworthy of the reputation of the establishment he controlled.

THE RESULT

An elaborate and expensive installation of salt-bath furnaces, pyrometers, recording instruments, etc., was at once purchased. The old hardener was not discharged, but put to work at the forge, as a bright boy who could watch the clock and instruments would with the new apparatus be able to do all the hardening for the establishment.

The concern selling the new plant started it up and made tests to ascertain the correct immersion times and temperatures for the steel used. Quite a number of the pieces they hardened were soft, but that was glossed over in the interest and discussion of correct hardening methods.

Once the apparatus was left for the use

of the company the following serious defects were quickly found: It took four hours' continuous firing to heat the baths hot enough to use, therefore the watchman had to light the furnaces and start the air compressor at 2 a.m. in order that a full day's work at hardening could be done.

This meant increased coal consumption under the boilers and, as the new process used more gas to maintain the heat besides that used to get the heat, the gas consumption for a certain amount of work was six times what it had been with the old gas furnaces. This gas was purchased from the city and was very expensive. The heat from the large body of molten salts was so excessive that a large ventilating system was found necessary before the furnaces could be used continuously. The salt fumes rusted everything in the establishment and even in the neighboring shops across the street. It was necessary to file-test every piece hardened (not thought of under the old method) as, for example, six pieces immersed together and taken out together might, or might not, all be hard; they could never be certain. The pots burned out more frequently, necessitating stopping for the day and night to cool off before they could be replaced. Soon the whole establishment was held up for hardened parts and the old furnaces were gladly fired up and the old "haphazard" methods resumed.

I am far from decrying the accurate doing of a thing, but in the hardening of medium sized steel parts the heating of them in a gas furnace which gives radiated heat only is to my mind as refined a process as is practical and satisfactory to use.

STEELWORKER.

Boring Bars and Cutters—How a Simple Inserted Cutter is Accurately Made without Taking the Bar out of Service

Herewith are some sketches showing a development of the round-cutter boring bar which I have used with a great deal of satisfaction and believe to be the best and cheapest way of arranging this type of appliance.

Fig. 1 shows a section of the bar with the cutter held in position. *A* is a spindle steel boring bar, *B* the cutter and *C* the centering screw. The following devices are used for duplicating the bars and cutters:

TOOL FOR BORING THE CUTTER HOLE IN THE BAR

Fig. 2 illustrates a boring tool which is fitted to a Woodruff cutter chuck and used in the milling machine for boring the hole central in the boring bar. Two of these tools are made for each size of hole in the bar. The cutting portion *D* in the case of the roughing cutter is made 1/64 inch below size, and the finishing cutter is 0.002 below size to allow for slight hand reaming.

HOW THE HOLE IS BORED CENTRAL WITH THE BAR

The boring bar is clamped on the milling-machine table and drilled approximately central with a twist drill. It is then "tipped" with the roughing cutter and the knee elevated the required amount, which is half the diameter of the bar plus half the diameter of the cutter. This operation is then repeated with the finishing cutter and the hole hand reamed to plug size.

A SPECIAL LOCATING PLUG

A plug, Fig. 3, is now used. This is rough turned, drilled at *E* and reamed. It is then hardened and ground at *F* to fit the hole in the boring bar, after which it is driven on a small mandrel fitting hole *E*, and dimension *G* is ground the same size as the boring bar. One of these plugs is made for each size of boring bar for the purpose of centrally locating the screw hole.

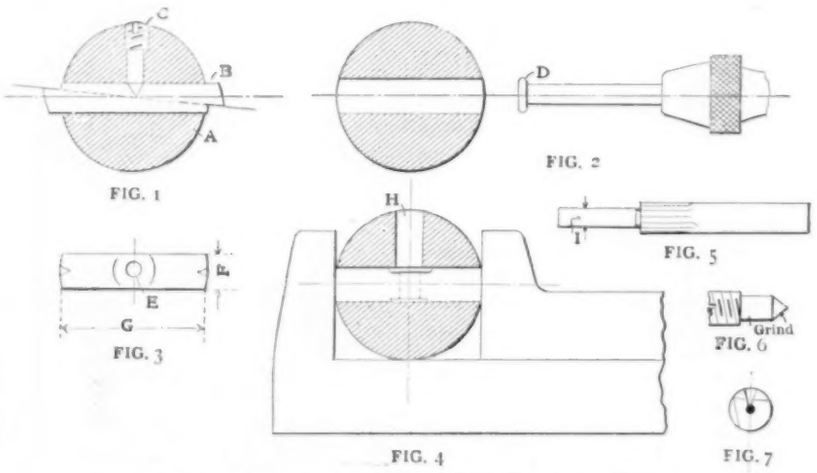


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7

TOOLS USED IN FITTING UP BORING BARS WITH ROUND CUTTERS

THE PLUG IN USE

Fig. 4 represents this block or plug within the boring bar in a drill vise and in position to guide the reamer. Screw hole *H* is now drilled approximately central and the pilot *I* of the reamer in Fig. 5 is inserted through the hole in the plug in the bar. Hole *H* is finished with this reamer and is tapped about one-third its length.

THE CUTTER SCREW

The screw for centering the cutter is shown in Fig. 6. It is made of tool steel hardened and ground on the straight portion to fit snugly into the bar and the conical portion is ground at the same setting. The thread of this screw is made an easy fit, so that inaccuracy due to tempering will not affect the point of the screw.

MAKING THE CUTTERS

Mandrels are made of the same diameter as the boring bars and have the same size of cutter holes and pointed screw for holding the cutters. The cutters are cut off and provided with small centers. They are then countersunk for the pointed screw and the faces milled as indicated in Fig. 7. After hardening they are ground to fit the bar. They are then held in the mandrel and circle ground to cutting size, the faces being ground for clearance and top rake and backed off.

PROPORTIONS OF CUTTERS AND ADVANTAGES OF TOOLS FOR MAKING

The holes in the boring bars are about one-fourth the diameter of the bar and the straight portion of the cutter screw about one-sixth the bar diameter.

These devices enable the user to complete all cutters without using the boring bar, which is often needed on regular work in the shop while extra cutters are coming through. It also takes us away from the old flat cutter which requires mortises in the bar, which few of our present-day filers are capable of getting correct.

ART ISAN.

The Specialist versus the All-around Man

I would like to see this interesting subject more fully discussed by your readers. Which man is worth most to his employer: the man who can turn his hand to anything, or the one who makes a specialty of one particular branch of the trade? Today the trade runs more to specialties, and whether that is a desirable condition or not is open to discussion. We have men who are lathe hands, milling-machine hands, boring-mill hands, etc. Very few men are familiar with all the different types of modern machine tools, and I think that almost all machinists who have adopted the title of all-round men could be sifted down to some specialty at which they would be more adept than at the others.

Another way in which we should look at this is in regard to the shop in which

we are employed. In a small jobbing shop it is absolutely necessary that a man should be an all-round man, as results come second to the ability to do anything. In this shop, a specialist would be lost as there would not be enough work in his line to keep him busy. On the other hand, in a large shop, there is enough work to keep planer hands busy planing, milling-machine hands, milling, and so on. In this shop, when hiring out, the man is asked what branch he has adopted and is hired to work at that branch. To claim to be an all-round man in a large shop is little or no recommendation, as it is seldom that the all-round man can equal the specialist in his line. The pay of the specialist is generally more than that of the all-round man, for as the old saying goes—"Jack of all trades, but master of none."

In our shop, the apprentices are put upon the different machines, for a certain length of time, until the last six months, when they are put upon the tools to which they seem most adapted, and allowed to make specialists of themselves. A curious condition of this specializing business is the fact that about all our bench hands are Swedish or German. Very seldom do you find the native American workmen at the bench. This may be because the apprentice in the old country has to serve a long time at the bench, and finds upon arriving in this country that there are more openings for bench hands than there are for machine hands, and he thus becomes a specialist at the bench. The young Americans, as a rule, admire the file at a reasonable distance. TEXAS

Boring Long Tubes—A Boring Scheme that Failed and One that Succeeded

One of the difficult jobs that is apt to come up sooner or later to every machine-shop foreman is the boring of long holes in solid bars, for tubes or barrels of cannon, or pieces of like shape, and unless he has had some experience in shops where such work has been threshed out, he is very likely to strike snags before he goes very far with the work.

Having had opportunity to see a good shop foreman meet his troubles in such work and to watch the method by which this work was finally turned out satisfactorily, I offer it for the interest of the readers of AMERICAN MACHINIST.

AN UNSATISFACTORY METHOD

The tubes to be bored were—in this case—15 feet long, the diameter of rough bore to be about 2¼ inches. Our foreman started out to bore with an arrangement about as shown in Fig. 1, using a twist drill on the end of a thick tube enough smaller in diameter than the drill to allow chips to escape. A feed of only about 0.003 inch per revolution could be used, and the drill had to be taken out for regrinding every four to five inches of bore. Finally, after about 3½ days of steady work the drill was cajoled into cutting its way through the full length of the tube blank, but in spite of opening up the hole carefully for several inches before starting the drill and using great care at each regrinding, it was found that the axis of the hole was something like 2½ inches eccentric with the axis of tube blank at the end where it came through. The tube and all the labor on it was, of course, a total loss as far as that particular order was concerned.

A SPECIAL BORING BAR AND CUTTER

Before going any farther it was decided that a boring tool of different design from a twist drill must be used, and the one finally decided upon is shown in Fig. 2. The boring bar used with this cutter had

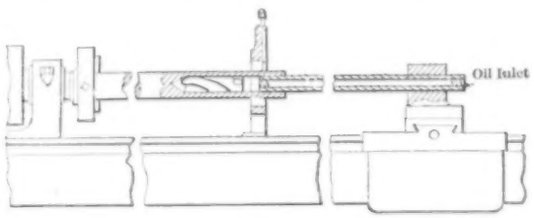


FIG. 1

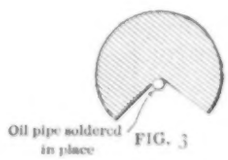


FIG. 3

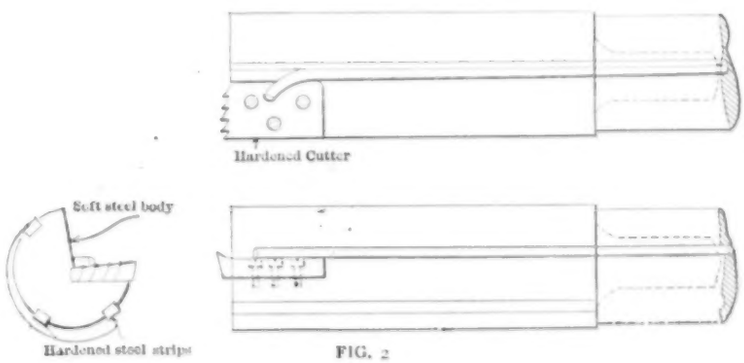


FIG. 2

BORING LONG TUBES

a section about as shown in Fig. 3, and this combination of bar and cutter was used, in the shop, on all subsequent work of the kind, giving a bore that had very slight eccentricity with the tube exterior. A feed of double the amount that had been possible with the twist drill was used. When in service the boring bar and cutter were held in about the position shown in Fig. 3, in order that the chips should have free egress along with the oil circulation. As will be easily understood from an examination of Fig. 3, the cutter removes the stock from the bore in small chips that are easily carried away with the oil. W. CANTELO.

Modern Manufacture of Copper Printing Rolls

The following will, perhaps, be of interest to mechanics and others who at one time or another have felt the need of a "putting on" machine—and what machinist or tool-maker has not experienced that want?

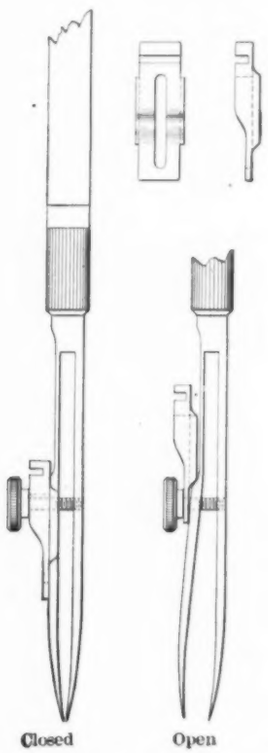
I was at one time employed in a shop in Providence, R. I., where they used machines that actually put on material where it was needed, and they did an excellent job. The firm made large numbers of copper rolls for use in print works. They were formerly made by taking a shaft and fitting a cast-iron head on either end. A sheet of copper was then rolled to shape, brazed together, and fitted to the heads or drums.

This method, while it made a good job for some classes of work, is not to be compared with the method they now use. The rolls as now made are a cast-iron cylinder of the desired size and length, journaled at each end. The cylinder or roll is turned smooth, or fairly so, and a rather coarse undercut thread is cut on it. The roll is then taken to a room that would remind you of a nickel-plating room, except that the plating tanks have bearings attached to each side, and they have the necessary shafting and belting overhead. The rolls are dropped into the bearings, and a pulley is attached to the rolls and belted up. The face of the rolls extends into the plating solution; the electric current is then turned on, and as the rolls are revolving all the time a deposit of copper is uniformly deposited on them—not a thin deposit, but one that ranges from one-fourth to about one inch in thickness. After being plated they are turned in a lathe the proper size, and then polished with Tam O'Shanter stone and water. In case the lathe hand should turn a roll undersize it has only to be returned to the plating-room, where it is re-

plated, and it is then ready for the lathe again. What a lot of worry and anxiety it would save if the same methods could be used in the steel and iron part of the business! WEST COAST.

Device to Permit of Opening a Ruling Pen for Cleaning, without Moving the Adjusting Screw

The sketch herewith shows how an ordinary ruling pen can be arranged so as to



A SLIDING WASHER FOR THE SCREW OF A RULING PEN

be easily cleaned. The bother of operating the screw to accomplish this is well known, and is often the cause of neglect. No explanation is necessary, as the sketch clearly shows its use. C. E. J.

The Engineer's Experience with the Irrigating Pump—Stopping Vibration in a Vertical Shaft

The following experience with a large pump was related by an old engineer:

I had charge at one time of a large centrifugal irrigating pump located near the Colorado river of Texas, from which the supply of water was taken. It was brought by a large flume which furnished all the water the pump could handle.

THE PUMP AND THE DRIVE

The pump had a suction and a discharge pipe of equal dimensions, 42 inches. The suction was 13 feet from the lower level to the pump, and the discharge was 14 feet from the pump to the irrigating flume, making a total rise of 27 feet.

A 450 horse-power engine, with a quarter-twist drive of 15 turns of 1½-inch manila rope, furnished the power to a 40-foot vertical shaft, at the lower end of which the pump was located.

TROUBLE WITH THE SHAFT COUPLINGS AND PACKING

This shaft was in three sections, connected by couplings held together with bolts. These coupling bolts and the shaft packing were continually jarring loose owing to the vibration of the pump.

The delivery flume, which was 12 feet wide and 6 feet deep, was kept supplied with water to within 6 inches of the top, and it had a fall of 1 foot in 100. The pump had a 1½-inch valve located at one side of the suction pipe, which when opened connected the interior of the pipe with the atmosphere; of course I kept this valve closed, because otherwise I could get no water when starting the pump.

A STEADY ANNOYANCE

Every time the pump, which made 300 revolutions per minute, was stopped I had to go down and tighten the packing and the coupling bolts. I did everything I could think of or hear of to stop the vibration, which I felt was unnecessary and could be stopped in some manner.

There was an old negro working around there, and one day he came into the pump house and noticed the shaking of the pump shaft.

"Boss," said he, "Why doan' yo' stop de jiggerin's of dat ol' pump?"

"Well, Sam, I've tried everything I can think of to stop it and haven't found anything yet that will take effect."

EXPERT ADVICE

"Ah kin show yo' how dat am stopped, boss."

"You can, Sam?" said I. "What do you think will stop it?"

He took me over to the well and pointing down to the pump, said:

"Yo' see dat li'l' wheel 'way down dar?"

"Yes, I see it."

"Yo' jus' go down dar an' tu'n dat li'l' wheel 'round two' t'ree times; dat'll make de ol' pump stop 'er jiggerin's."

THE COLORED MAN'S OPPORTUNITY

Knowing that common practice was to exclude all air possible from the suction pipes, I began to think some trick was in the old darky's head; he assured me, though, that he meant what he said and that he could stop the trouble. Thinking that, although it was rather queer for an old colored man to tell an engineer how to handle any trouble like that, it was up to me to find out how to get rid of the vibration as soon as possible, I said: "Sam, you go down there and do just what you think should be done and we will see what the pump will do."

Sam never hesitated, but went down and opened the 1½-inch valve at the side of the suction pipe and came back up to the top of the well.

THE RESULT OF EXPERIENCE

Before the valve was opened the water in the delivery flume was six inches below the top of the sides, and after the valve was opened the pump and shaft quit vibrating and the water rose to the top and overflowed the flume.

I have had the theory explained to me that the amount of air which was let into the side of the suction pipe formed a sort of cushion in the water and helped the pump to work more freely. The 1½-inch opening in this case increased the capacity of the pump and took away all vibration.

It is needless to say my colored man was older on that job than myself.

G. G. L.

Another Way to do Another Crank-shaft Repair

I note at page 771, Vol. 29, Part 2, "another crank-shaft repair." Had the party possessed certain information, which unfortunately is rare, he might have obtained equally favorable results at a portion of the cost and trouble. In fact, the method that I describe may be performed in many instances where there would not be facilities for heating, re-turning, or forcing on.

This method is so simple and so easily performed that most persons would not expect success unless they either knew of its past use, or else had a knowledge of the action of metal under heavy stress. It consists merely of boring a hole in the shaft longitudinally within the loose junction, of ¼ to 1/3 of the diameter at that point, and forcing in a slightly tapered, smooth pin either by driving or forcing means, which enlarges the shaft, and causes a tight fit again. This is done entirely cold, and merely expands the metal, and is an entirely safe proceeding. Large engine cranks have been successfully repaired in this way, without even disconnecting, or using any means other than a temporary rig to bore the hole, a suitable ram to drive in the tapered pin, and, of course, cold chisels to trim off the projecting part of the pin when sufficiently driven. An engine has been run several years after being thus repaired, with no further trouble, and the succeeding engineer did not know until told of the fixing, even after running the engine two years.

This method is eminently suitable for marine repairs, and for many conditions where it is impossible or inadvisable to make expensive shop jobs.

F. R. WILLIAMS.

Jobs in Dirt and Discomfort—Making "Running Repairs" on Locomotives—A Few Reminiscences

Mr. Osborne's story, at page 799, Vol. 29, Part 2, of the machinist who was confronted by a disabled planer, the fixing of which meant a job in dirt, darkness and discomfort, brings recollections to my mind, and I venture to offer a few of them, thinking they may possibly entertain some of the readers of the AMERICAN MACHINIST. I have, however, no intention of trying for a record among the anecdotes which, doubtless, will as usual re-echo to Mr. Osborne's prompting.

If that man quit because of *once* running up against a distasteful proposition, I wonder what he would have thought of a job in a railroad roundhouse where you work every day in the month, and frequently many hours over-time at night, and at jobs in dirt and discomfort as a regular thing. I don't mean one of those nice, new, bright, modern brick and steel roundhouses, of which the railroads have built several in these prosperous times, with floods of light coming through the vast amount of glass in the sides, with heating and ventilating apparatus put in by some big engineering firm expert in that line, and with well drained concrete pits, patent smoke-jacks that really carry off the smoke, etc. No; I mean one of the older style, on a road which has so much traffic in proportion to its equipment that the motive power is worked to the limit, and engines must be kept moving with as small a percentage of delay at the terminals as possible: a frame building with a few louvres in the roof, and a very few steam coils and two or three coal stoves, the latter serving chiefly to prevent the gang bosses from freezing, as they have no exercise to keep them warm. I will try and give a little idea of how it was.

THE ROUNDHOUSE IN COLD WEATHER

You are lulled to sleep by the music coming from the railroad orchestra in the yard across the road, consisting of puffing exhausts, the steady rhythmic clang of the pneumatic bell ringer, the bumping of freight cars, and above all the everlasting hiss of steam from numerous pop valves and cylinder cocks. Occasionally a whistle shriek causes you to lie awake and listen to a Baldwin compound a mile or two away going up the hill—you know it for a Baldwin compound by the subdued exhaust and that characteristic "blippin, bloppon, blippin, bloppon" that comes from the cross-heads (Baldwin's were not making balanced compounds then). But being too tired to be much bothered by the noises, you sleep soundly until the rising bell rings, when you reluctantly get up, hustle into your clothes and rush to breakfast and then out across through the yard, in the early morning gloom, stepping carefully over numberless frogs and switches, down the icy tracks to the roundhouse, and, with the habitual and automatic caution acquired by the man who works in a railroad yard, constantly looking up and down to save yourself from being run over. You pass the ash-pit, coal pockets, and sand-house, where rows of engines are standing almost concealed by the clouds of white steam in the frosty air—air away down below zero, that would come near freezing superheated steam; then into the middle of the circle, with its turn-table in the center and its radiating tracks, which during the day is as a circular fortification cutting you off from the outer world. You get into your over-clothes and gloves—yes, gloves, and you are not ashamed of them either, nor would any other machinist be if he worked under such conditions.

In that roundhouse, in the winter-time, was an atmosphere which I believe was the worst combination of bad quality with exceedingly low temperature I ever saw, —and I am not afraid of cold either. Some of the big hinged doors are open awaiting a chance to get an engine out on to the turn-table, or because a new engine is so long that its tender won't go into the house far enough to allow the doors to be closed. Right near the open doors the air is not so thick, though the cold wind would freeze your breath. But some distance from the door it is nearly as low in temperature, and the dampness more than makes up for the absence of wind, for a fog formed by a mixture of steam and smoke which can't get out of the house extends from the pits to the wooden roof. I have often seen it so thick that in the day-time you couldn't see your own feet, and could scarcely see your hands, so that you have to use kerosene torches all day long. These latter, placed close beside you or in front of you day after day, make a nice fine deposit of lamp black on the interior of your lungs—in the bronchia, at any rate. Sometimes the fog is given a pungent flavor by the wood smoke from an engine one or two tracks away, in which a fire is being kindled, so that your eyes stream with water.

When you get a job that keeps you standing in one place a long time, you hunt for a piece of asbestos boiler lagging, and heat it up in one of the boilermakers' portable rivet forges, and then stand on it. A considerable portion of the work is done from under the engine, and you spend a lot of your time in the pit, often the greater part of the day. The pits are lined with planks, and their builders, by some inexplicable inspiration, had them dug three or four feet deeper than necessary, and then put in a false floor. Underneath the floor there is a depth of about three feet of dirty water, like the bilge-water of a ship. Occasionally a chisel, wrench, bolt, valve-motion pin, or something, slips through the cracks between the boards and goes down into that water (which is sufficiently protected not to freeze, but is still pretty cold), and you roll up your sleeves, thrust your arm down, and go fishing in the bilge until you get it.

PLENTY OF DIRT

But talk about dirt — I was rather amused when I read about Mr. Osborne's machinist endangering his suit of clothes, and I thought of the dire treatment my clothes used to get all the time. In the back shop the dirt is not so bad, because the wiper boys and the superannuated laborers have a chance to do a pretty fair job at cleaning; but in the roundhouse there is often not time for much to be done in this line. Any observant traveler knows that valve motion gets its share of oil. It is down near the dust and mud of the road-bed, and there is an elegant slush, composed of grease, mud and cinders, over these parts, as well as on the frames and other parts which you must handle or rub against. Often the coating is an inch thick. And as for your clothes—well, you wear overalls with a long bib, and under that a jumper; but all the same at night you will find black splotches on your underclothes and on your skin where the grease has worked through all the defenses. Your face after you have been under an engine for a few hours is like that of a coal miner. Although when leaving the shop you scrub hands and face with brush and tar soap, or a mixture of soft soap, engine oil (if you can get any) and sand from the engine sand box, still the minute you get home you hit the trail for the bathtub. The laundry soaks your overclothes in kerosene—you wouldn't like to ask your wife to wash them, unless maybe she is anxious for exercise. The renewal of working gloves is a frequent occurrence, as they very quickly wear and rot out under the hard service.

When the engines come in off the mountain, they are suggestive of an advertisement of a soda-water fountain, with immense icicles dangling from the tender and from under the engine itself. Down in the pit, you rap with your hammer on the injector overflow pipe (a long pipe coming down from the cab, and closely following the curve of the boiler) and you find that a long curved core of ice comes down out of it piece by piece—and the water which goes into that overflow is pretty warm too.

DIFFICULTY AND HASTE ADDED TO COLD AND DIRT

But I was going to talk about uncomfortable jobs. Well, if you ask a roundhouse man what job he hates most, he is quite likely to tell you it is "lining up wedges on a hot engine," say one of those old-style consolidation engines with small wheels, and ash pans only a few inches above the rails. The braces, shoes, and

wedges on the big modern engines are heavier and harder to handle, but the engines are higher and their grates away up above the track, and there is some room to work; but on the last two axles of the little old fellows it is pretty hard to reach the shoes. The wheels are small in diameter, their centers are of gray iron and have spokes much thicker than those of the modern cast-steel centers, so that you can't reach anything between the spokes from the outside, and, from underneath, that infernal ash pan almost blocks you out altogether. Though you are, perhaps, thoroughly imbued with principles of cleanliness and hygiene, you have got some grit, too, and down you go onto the floor in the grease and tobacco juice, and squirm through the triangle formed by the rail as a base and portions of the driving-wheel treads as sides (getting through here is quite a gymnastic stunt in itself—fine for cultivating pliability) until you feel your feet on something solid, and you think you can raise your head without danger of making an impact test of a spheroidal plate of bone. Remember, also, that the engine has steam up, and, to add to the interest, you have such little discomforts as occasional hot cinders falling out of the ash pan, or hot water from the injector overflow, gage cocks, pet-cocks, or leaks, trickling down on your neck. Besides, all the time you know there will be the deuce to pay if that engine isn't ready in time to go out on her run. You are glad when you get those shoes out, and you are gladder still when you get them back again with the right thickness of liners between them and the pedestal legs. Sometimes the shoes don't come down right away after the removal of the bolts and pedestal caps, or binders, or, as the shop men say, "braces;" then you tap them a little with a sledge. But they are likely to take a notion to come down very suddenly, and if you are not careful, you may become good practice material for first aid to the injured. By the way, the sledge hammer is an implement much used in locomotive repair work, and you often have to swing it in some mighty close places, where if you are not skilful you side-wipe a transverse frame brace, or something, and the heavy hammer swats you one on the side of the head or in the face.

To fire a big freight engine, on a run over a division 140 miles long, is no soft snap; but yet a fireman with such a run stated that he would rather have his job than the roundhouse job I am describing.

A JOB WHERE YOU WISH YOU WERE SMALLER

Speaking of close quarters, one of the closest places in which I have had to work was when I had a throttle job on an old-style engine (a type with a narrow and long fire-box and the cab at the rear) where the throttle rod instead of coming out through a stuffing-box in the back head of the boiler or in the dome, is connected to a crank in the steam space of the boiler, on the lower end of a short vertical shaft passing up through a stuffing-box on the roof sheet, and carrying the throttle lever on its squared upper end. The dome was well forward on the boiler, in fact farther forward than the tube sheet, and the long rod extended from the bell crank in the dome to this crank, back over the crown sheet. In order to get at the inner works of this contraption, you get down through the dome (or "doom" as railroad men for some strange reason call it) onto the tubes, and then work your way back over the crown sheet between the labyrinth of stays, until you can reach the back end of the rod. But getting out again is still worse, and you begin to wonder whether it won't become necessary to have the boiler-makers cut out some stays, as a lumberman cuts a path through a forest, so that you can get out.

"STICKING IT OUT" VS. QUITTING; BALANCING MOTIVES

Our machinist is not a quitter, and he sticks this sort of job out, rightly believing that he can learn a lot about the iron horse, its troubles and their remedies, by practically living in its stable for a period.

Mr. Osborne's machinist was of the opinion that the game was not worth the candle; well, that is a matter of personal taste rather than of reasoning, and the old saying is, *"De gustibus non est disputandum"**. There are many degrees of the game; the North Pole would never be discovered if all men thought as the majority of us probably think, that for them the honor of being the first man at 90 degrees north latitude is not worth the peril and suffering of getting there. The same thing applies to lesser games and lesser candles, and each man must make for himself his own estimate of the relative values of games and candles. He may subsequently find that his estimate should be revised, or perhaps that it is very erroneous, because at the time he made it he was not fully informed. I notice that Mr. Osborne's man changed his views afterward, and concluded that the satisfaction of fixing the planer would have been worth the trouble.

A WARM SEAT IN A HOT SUMMER

Later, in the course of events, being in a warmer climate, our machinist runs up against discomfort at the other end of the scale; this time in midsummer instead of midwinter. A big freight engine turns turtle on a viaduct and plunges into a marsh. All sorts of things are broken off her in the smash-up, and the steam and water escaping make a regular "fango," or hot mud bath, of the marsh. Her salvage gives the wrecking crew a chance to display its skill, and after several days she makes her appearance in the erecting shop, reminding one of a football player after a hard battle. Her boiler has brought along abundant specimens of the geology of that marsh, and, as the reader is probably familiar with the general construction of a locomotive boiler, with its water-legs full of staybolts, he will appreciate that that mud is pretty thoroughly keyed, as a plasterer would stay. Well, the boiler washers go to work immediately with steam hose, and force boiling hot water under high pressure through various hand-holes and openings into the boiler, and keep at it steadily until that mud is all out.

Meanwhile, the machinists have to begin by getting her stripped as quickly as possible. It is the middle of August, and a hot August at that, the Weather Bureau's thermometer being about 100 degrees in the shade; the engine is one of the biggest on the road, and the number of British thermal units which that boiler can store up inside of it is something quite respectable. So when you have to sit on top of that huge steel cylinder (the lagging is all torn off by this time) with its warm contents, and take off the manifold, throttle rigging, lubricator, gages, sand-box and rigging, etc., etc. (or their battered remains), often having to use hammer and chisel on mutilated parts, you do think longingly of that cool river flowing through the woods some miles out the road. You are grateful, even, when you have to drill out broken studs with an "air motor" and get a chance once in a while to place your wrists in the comparatively cool air from its exhaust. All the same, you consider yourself better off than the engineering and steam-fitting forces in some power-houses you have seen, where the piping is all under the floor, and where they have to grope down in that hole with the thermometer at 140 degrees, or thereabouts, and clouds of steam—real hot steam at that—escaping from a leak which they must find and fix.

THERE ARE OTHERS WORSE OFF THAN THE MACHINIST

I think the boiler-makers are probably worse off still, when an engine comes into the roundhouse with some leaky tubes reported and she is called for a few hours later, say to take a train of perishable freight East. The fire is dumped, some planks thrust into the fire-box, and the blower turned on to induce a draft of fresh air through the fire-box and tubes. The boiler-maker crawls through the narrow door into that steel box, surrounded on all sides (excepting, of course, the bottom) by water and steam at a temperature of perhaps 375 degrees Fahrenheit, and you may be sure he gets those tubes rolled as quickly as he can. It may even happen that the fire is not dumped, but instead is covered with damp coal and wet planks put in for the man; obviously in this case the blower is not turned on. Of course,

*"There is no disputing about tastes."

we don't forget the hot jobs that some workers in the steel mills have; but this is probably getting too far away from the machine shop.

CHIPPING IN A NARROW SPACE

Mr. Osborne's man would have had to lie on his back like an automobilist tinkering with a "devil-wagon" broken down on the road. That reminds me of another little job on a locomotive where one lay on his back, but it was not quite like lying on cushions in a hammock. This was not a case of dirt, but of a job which was rather hard to get at. A new left-side cylinder had been put on an engine, and when she went out on a trial trip it did not need an indicator to show that she was lame on the left side. Of course, the first thing was to go for the man who set the valves:

"How about this lame engine? Are you dead sure everything was right?"

"Yes, sir, I would swear I didn't make any mistake—divided up the lead equally and all."

"Well, if you stick by your valve-setting, we'd better examine the cylinder; open her up at once."

So off came the steam-chest cover and the front cylinder head, and the piston was withdrawn. A careful examination of the ports disclosed what ought to have been found before the cylinder went out of the shop; whether it was caused by a broken or displaced core, or what, I don't recollect now; but at any rate there was a lump of iron right in the back port, and I had the job of getting it out. So I lay down on my back and squirmed head first into the cylinder, and soon was pretty thoroughly occupied with simultaneously maintaining my awkward position, keeping the electric light shining as much as possible into the port and out of my eyes, and, hardest of all, swinging my hammer in that limited space so as to chip out that lump of iron up in the port—also endeavoring meanwhile to keep the particles of cast iron from falling into my eyes. The job was done satisfactorily in a reasonable time, however, and the locomotive soon went back with an even exhaust, to her job of hauling "steel yachts" full of coal.

Of course, I do not want to create the impression that all railroad engine-houses are like the one described, or all jobs in them have so many discomforts. However, life in a busy roundhouse is likely to be somewhat more rough and strenuous than a job running a lathe in the "back shop," or tool-making. In spite of the drawbacks, it was all very interesting, and it is quite a satisfaction to look back and know that you never shirked a job because it was too dirty or too disagreeable.

BRACHISTOCHRONE.

The British navy is to have a repair ship of about 11,000 tons and carrying a crew of 300 men.

French Industrial Art—The Artistic Ability, which, in Spite of Handicaps, Makes a Wealth Producer of the Nation

The reasons why France excels in the production and sale abroad of such a wide range of manufactured goods are discussed by Consul-General Frank H. Mason, writing from Paris. He states that two classes of American exports alone have succeeded in gaining a foothold in foreign competitive markets, viz., food products and raw materials, and a certain limited list of manufactured goods. The latter consist of articles turned out in large quantities mainly by the use of ingenious and highly effective machinery, working upon materials which the natural resources of the country supply in abundance, and operated by working people who, by doing one thing continuously day by day and year by year, have learned to do it remarkably quickly, cheaply and well. Under this system of specialization there has grown up in the United States a multitude of automatic workmen, who, for the kinds of subdivided work in which they have been trained, are incomparably efficient.

The articles referred to include: Machine tools, of which Consul Mason states that there is nothing made in Great Britain or continental Europe that surpasses in quality of material, or equals in consummate workmanship and ingenuity of construction, the high-class automatic machine tools of the best American makers; also typewriting machines, agricultural machinery and implements; the American sewing machine, and the American factory-made shoe; fine hardware—locks, hinges, etc.—and American silverware, the machine-made watch, and various mechanic's tools.

THE PRODUCTS OF FRENCH GENIUS DEFY THE TARIFF WALLS OF OTHER NATIONS

It is stated that this is all very well so far as it goes, but there is a whole realm of production in the higher and more artistic forms of manufacture that machinery and automatic workmen do not reach. For all this—the products of skilled handicraft into which has been wrought some of the personal genius and character of the workmen—we are still almost wholly dependent upon European countries, and especially upon France. The last-named country, notwithstanding limited natural resources in respect to coal, iron and other metals, and with not a pound of cotton or petroleum produced within her borders, with a stationary population and heavy burdens of public debt and national defense, is one of the most prosperous of nations. Paris, gorged with money, has become the banker of continental Europe. The underlying sources of this prosperity can be summed up in a sentence, namely, a genial climate, a soil naturally fertile and kept to the highest point of production by intelligent, intensive cultivation; industry and frugality of living on the part of the working classes, and above all the instinct of artistic taste, fostered and developed by education and governmental influence until it has become a national attribute. France is industrially prosperous because she commands the rarest and surest of assets—the esthetic taste which creates models and standards for other people and the consummate handicraft which multiplies in the product, ten, twenty or a hundred times the value of the material of which it is composed.

THE UNITED STATES CAN LEARN FROM FRANCE

The lesson which the United States may learn from the foregoing is obvious: This country can not continue indefinitely to depend for commercial eminence upon the depletion of its soil, waters, forests and mines, but justice to posterity requires that we should lay the foundation for the higher and more subtle industries, the products of which are so highly appreciated in America, and now come almost exclusively from the Old World. It means that we should follow the example of France and Germany in practically recognizing the value of specialized education. As an individual example in this matter, we may refer to the AMERICAN MACHINIST, page 721, Vol. 29, Part 2. How many smiths can be found in the United States who are capable of doing the work described in that article?

The Size of the Atom

John A. Brashear, in an address delivered at Lehigh University a short while ago, gave what seems to be a new illustration of the minuteness of the atom. Quoting Lord Kelvin's saying that: "If we raise a drop of water to the size of the earth and raise the atom in the same proportion, then will it be some place between the size of a marble and a cricket ball," Mr. Brashear then said:

If you fill a tiny vessel one centimeter cube with hydrogen corpuscles, you can place therein, in round numbers, five hundred and twenty-five octillions (525,000,000,000,000,000,000,000,000,000) of them. If these corpuscles are allowed to run out of the vessel at the rate of one thousand per second it will require seventeen quintillions (17,000,000,000,000,000,000) of years to empty it. Such a computation seems almost like trifling with science, indeed apparently trifling with the human intellect; but it is with these subtle theories that our physicists are wrestling, delving into the innermost chamber of the infinitely minute, to build for us, upon the most stable foundation, the macrocosm of a universe.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E.C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications of the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1906 the AMERICAN MACHINIST printed and circulated 1,083,205 copies, an average of 20,832 per issue. Of this issue 19,500 copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.

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A. S. M. E. Meets in the New Engineering Building

The evening of January 8 was signalized by the first use of the new engineering building in New York for a meeting. The occasion was the first of the local monthly "reunions," which have been held during the earlier months of the year for some years past. The speaker of the evening was Frederick P. Fish, of Boston, president of the American Telegraph and Telephone Company, whose subject was "The Ethics of Trade Secrets." As this subject is of interest to all engineers, invitations were extended to members of the other engineering societies to be present, with the result that the large auditorium was nearly filled by an audience which in the points of comfortable seating room, light, ventilation and opportunity to clearly see and hear the speakers could scarcely have wished for anything more or better.

Mr. Fish's address, from which we shall soon print abstracts, was well worthy of the occasion, and was listened to with the deepest attention, and the entire affair was in the highest degree successful.

It seemed especially fortunate and appropriate that though, as it happened, the American Society of Mechanical Engineers was the first of the participating societies to make use of the building, the address of the evening should be delivered by a man not a member of the American Society of Mechanical Engineers, but of the Institute of Electrical Engineers—invited to deliver the address because he is one of the best living authorities upon the subject on which he spoke. The essential unity and close inter-relation of all engineering work was thus clearly exemplified by the first use of the new building, erected for the joint use of the national engineering societies.

A perspective view of the building, with plans of several floors, was given at page 64, Vol. 29, Part 1, and the building itself more than justifies the expectations formed of it. The main auditorium, especially, is magnificent in effect and worthy of any audience in the world. It is, in fact, to the auditorium that ornateness of treatment has been chiefly confined. Elsewhere the treatment, as befits the purpose of the building, is massive and dignified. If any man were ever to be congratulated on a good resolution well executed, it is Mr. Carnegie. Certainly it is worth while to be able to do such things as this.

In opening the meeting President Hutton remarked that it was to be considered as informal, the opening ceremonies being necessarily deferred until next April. The building will, however, be used in the meantime, both for offices and for meetings, and the Mechanical Engineers already occupy their suite of rooms. Their offices, together with the other floors, were thrown open for inspection, both before and after the lecture, and, the elevator service being in full commission, the building was inspected from ground floor to roof.

The only note of regret heard during the evening, and this was heard many times, was that the Nestor of American engineering societies—the American Society of Civil Engineers—should not be a party to the occupancy of the building, and thus round out in full measure the idea of engineering unity which it is intended to emphasize. We have never been able to understand the refusal of that society to enter the circle, and if the full meaning of this engineering headquarters could have been realized, such refusal would have been impossible. As pointed out by President Hutton, the building and its underlying idea are unique. Nowhere else is there such an enterprise, and many years must elapse before another is seen, if indeed another is ever seen. It is a pity of pities that its idea could not have been carried out in its completeness. At the same time, the loss is chiefly to the Society of Civil Engineers. To others the loss is sentimental; to them it is actual, and we have no doubt that they will ultimately realize the fact as others already do.

Overpayment of the Railroads for Carrying Mails

According to figures compiled by representatives of the United Typothetæ of America and the American Weekly Publishers' Association, the railroads are receiving for the carrying of the mails an average of three times as much as they would receive for the same service performed for the express companies. It is asserted that during the fiscal year ending June 30, 1907, the Government will have paid the roads almost $32,000,000 more than the express companies would pay them for hauling an equal tonnage for an equal distance. The tendency in some quarters will of course be to charge this abuse to the Post Office department, and to say that it is only another proof of its mismanagement, and of the unwisdom of Government administration of anything resembling a business affair. As a matter of fact, however, the payments to the railroads are fixed by Congress, and the Post Office department has little or nothing to do with it. If Congress will right this matter, and if it will also charge to the various other departments of the Government the cost of carrying their mails, which is now charged to the Post Office department by means of the franking privilege, there will be no longer any deficit in the Post Office department, and no necessity for disturbing the postal arrangements upon which the publications of the country have been and are based.

The Universal Milling Machine as a Cam Cutter

Elsewhere in this issue is a communication signed "Milling Hand," which describes an entirely new function of the universal milling machine, and constitutes what we consider an important addition to the literature of cam making.

We shall never know when we have arrived at the end of the possibilities of the universal milling machine. For years thousands of men sat in front of the index plates and pins of such machines, and used them without noticing the fact that they were capable of a differential or a compound movement. The final discovery of this fact and its description in our pages led to the regular use of the machine in this way, and finally to the gearing of the plate, so that it is moved in a predetermined ratio to the movement of the index pin, in such a way as to give every division up to 380. We now have the description of a process by which ordinary cams of almost any proportions can be cut without the use of special appliances, and by the application of a simple mathematical formula, which, in the article referred to, is clearly illustrated and explained. The article is a most interesting and important one and will be put aside for future use by many an expert milling-machine man.

Meeting of Electrical Engineers —Electric Motor vs. the Locomotive

The 213th meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineers' Building, 33 West Thirty-ninth street, New York, on Friday, January 25, at 8:15 p.m. The following paper will be presented by Lewis B. Stillwell and Henry St. Clair Putnam: "Substitution of the Electric Motor for the Steam Locomotive." The paper will include:

1. Presentation of certain facts established by experience in the operation of elevated, subway, and interurban lines by electricity.

2. Discussion of comparative cost of operation by steam and electricity applied to railways in operation, and including both passenger and freight service.

3. The importance of standardizing electric railway practice.

4. The question of frequency in the operation of railways by alternating current.

Members of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the New York Railroad Club, and the Transportation Club are cordially invited to attend this meeting.

The First Words Spoken from the Platform of the Large Auditorium of the Engineering Building

Prof. F. R. Hutton, president of the American Society of Mechanical Engineers, in introducing Mr. Fish as the speaker on the evening of January 8, in the auditorium of the new engineering building, made the initiatory address from the platform of that auditorium. Readers of this journal who are members of the society, and probably others as well, will be interested in it, and we therefore give it in full as follows:

It is the wish of the American Society of Mechanical Engineers, under whose auspices we are holding this meeting tonight, that we should regard it distinctly as an informal gathering and not in any sense as the official opening of the Engineering Societies' building. For reasons of weight, connected with our desire to have the founder and donor of the building present at the time that such official opening shall take place, it will not be held until the month of April. On the other hand, it has seemed very undesirable to hold the building closed and unavailable for its uses until that formal opening should take place. The societies, therefore, who are the beneficiaries under Mr. Carnegie's deed of gift, and the other societies who are the associates with us in the management and benefits of the building, will begin at once to hold their meetings in the auditoriums of the building. The Society of Mechanical Engineers happens, by lucky coincidence, to be the first of the bodies to hold its meetings in this room. The Institute of Electrical Engineers will hold its meeting by appointment on Friday, the 25th of January, 1907, at a quarter past eight; and the Railroad Club and other organizations will begin on their stated meetings during the month of January and thereafter. The American Society of Mechanical Engineers has reserved for itself the second Tuesday of each month and meetings will be held here on the second Tuesday of January, which is tonight, and February and March and April.

I think, however, that I should be sluggish and inert if I did not on your behalf give a voicing to the thrill and tingle of my own nerves tonight, that it should be given to me to call you to order, and to you to be called to order, this night for the first reunion in this building.

It is, I think, a matter which is singularly noteworthy that in the history of engineering in this country, and also in the history of civilization and, therefore, in the history of the world, a gathering should be held like this for the first time in a building devoted to the interests of engineering in its diverse specialization, and a building intended to emphasize at once the diversity of these specialties and their fundamental unity. Nowhere else is there a building like this, in which the different branches of engineering are met together as one, and where their unity is to be emphasized by their meeting for conferences, by the existence of a joint library, by the gathering together of their executive officers under one roof. It is a great thing to be the first to do anything. You can never do anything the first time twice. (Applause.)

Therefore it seems to me that there is an especial significance in our being gathered together tonight for the first time to listen to the first paper to be delivered in the building of the engineering societies. It adds especial interest to me, in introducing the speaker of the evening, that while addressing the American Society of Mechanical Engineers on the subject allotted to him, he should address us as an associate member of the Institute of Electrical Engineers, emphasizing in that position of his, and in his relation tonight as our speaker, the fact that we are coming together in one under the roof of the Engineering Societies' building. It is the purpose that tonight, after the address has been delivered, there should be no discussion held of Mr. Fish's paper; but that any member of the society, feeling interested enough and desiring to contribute, should do so in writing thereafter in order that it may be presented in written form for consideration by the speaker. The object of this inhibition tonight is that full opportunity may be given for the inspection of the building after the close of the address. The suggestion is made that you should go to the top of the building, which is the library area, and then to the floor next but one below, the eleventh floor, which is the floor of the American Society of Mechanical Engineers; and then follow on down through the smaller auditoriums on the level above this. It is supposed that this room holds about one thousand when fully seated, but there are smaller auditoriums on the floors above which are also ready for occupancy by the organizations who want to use areas of that size. We ask your inspection of the smaller rooms.

In introducing Mr. Fish as the speaker of the evening I introduce him as an associate of the Institute of Electrical Engineers, as the president of the telephone company, as a lawyer who, having given careful and exhaustive study to the problem on which he is to address us, and as a man capable of broad views on any subjects submitted to him. With this introduction, I have great pleasure in presenting Mr. Frederick P. Fish. (Great applause.)

The Skinner Chuck Company, New Britain, Conn., gave a reception and supper for its employees at the Hotel Russwin, December 26.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A VARIABLE-SPEED GEAR

The illustrations show a variable-speed gear of the expanding-pulley type. Fig. 1 shows an end view, Fig. 2 a view from underneath, and Fig. 3 a view of the various parts.

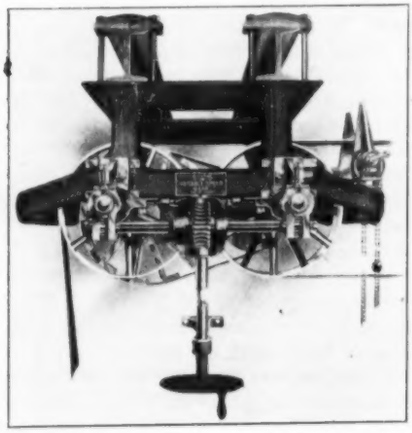


FIG. 1. END VIEW OF VARIABLE-SPEED COUNTERSHAFT

The rim of each pulley is made up of 12 sections, with two spokes riveted to each. These spokes slide in slots in the hub. Part of each spoke inside the boss has teeth milled on it which engage with the pinion shown in the sectional view in Fig. 3. This pinion is worked by an internal shaft, which is capable of longitudinal movement. At one end, this shaft has a series of helical grooves which engage with the pinion, any longitudinal movement of the shaft rotating the pinion and expanding or contracting the rim of the pulley. The other end of the internal shaft is provided with a sleeve or quill upon which there is a rack by means of which the shaft is given its longitudinal movement.

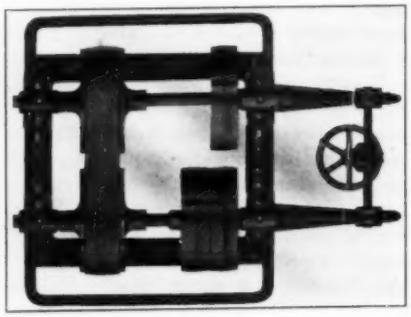


FIG. 2. VIEW FROM UNDERNEATH

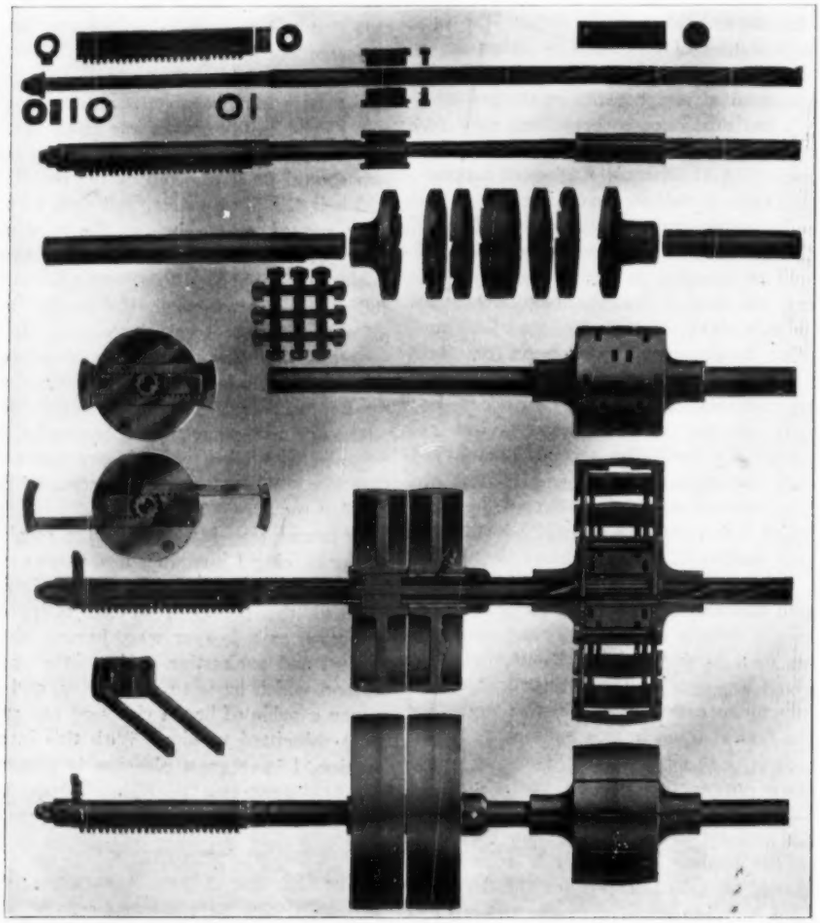
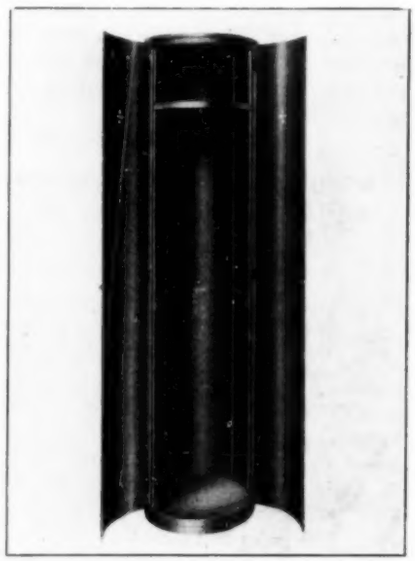


FIG. 3. THE COMPONENT PARTS OF THE VARIABLE-SPEED COUNTERSHAFT

These pulleys will give any ratio up to 4 to 1. They are made in 14 standard sizes, capable of transmitting up to 128 horse-power. They are built by the S. & S. Engineering Company, 581 Park place, Brooklyn, N. Y.

A CYLINDRICAL ALL-METAL LOCKER

The illustration shows a shop locker, made of plain or galvanized metal, which may be of either plain, perforated, or expanded sheet. Owing to the double door construction, the floor space occupied is reduced to a minimum, that necessary for a 14-inch locker being but 18 inches. When set up in batteries, these lockers, if desired, can be set upon a support requiring but one standard at each end of the battery, thus making it easy to reach under them with a broom.



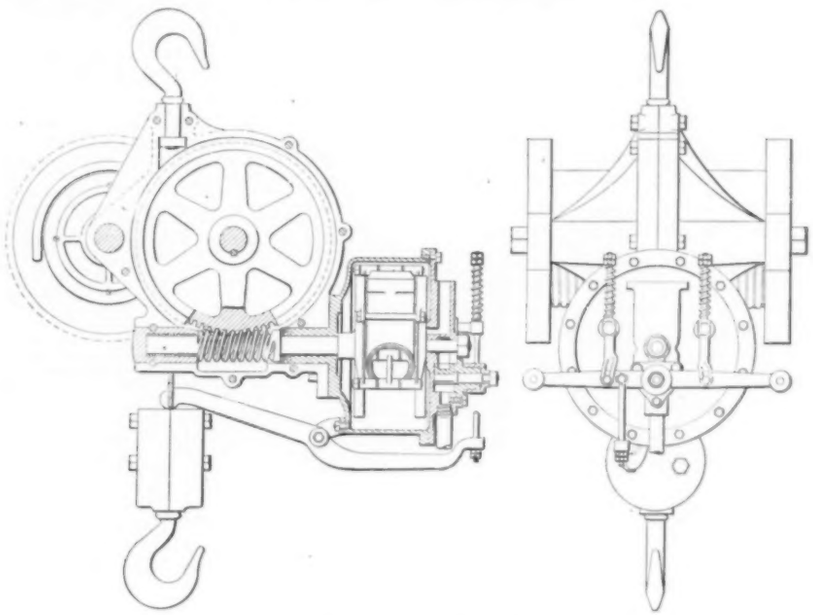
A CYLINDRICAL ALL-METAL LOCKER

They are manufactured by the Manufacturing Equipment and Engineering Company, 209 Washington street, Boston, Mass.

THE IMPERIAL AIR MOTOR HOIST

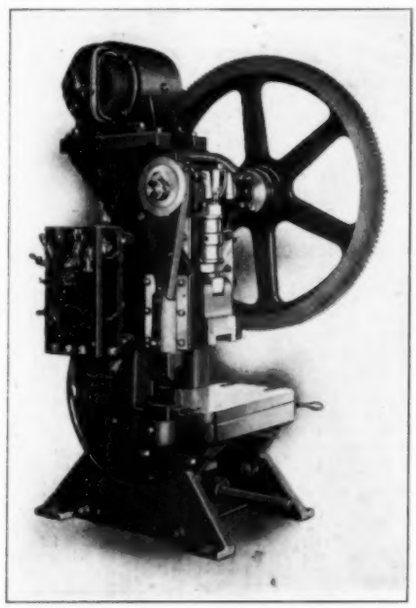
The Imperial air motor hoist here illustrated, is a recent product of the Ingersoll-Rand Company of this city. Where a supply of compressed air is available, the air hoist is a great time- and labor-saver. The present hoist, unlike the direct-acting machine, does not require a great hight above the lift, and no more hight for a high lift than for one not so

high. The movement is perfectly controlled both for hoisting and lowering and the load is positively held at any point desired. There is no waste of air in filling long cylinders, the amount used at any time being that required for the actual work only.



THE IMPERIAL AIR MOTOR HOIST

The motor is a positive-action reversible air engine, with no dead centers and a practically uniform torque. It has no delicate valve mechanism and is wholly inclosed, dust-proof, and splash oiling. The steel worm on the motor shaft runs in an oil pocket, its thrust being taken by a roller bearing, and meshes into a worm-wheel of bronze, a pinion on the worm-wheel shaft engaging the drum shaft gear. On the larger sizes of hoist there is an additional speed reduction The hoisting rope underruns a groove in the hook block, which always permits an exact equalization of the load on the two ends of the drum. The hook turns on ball bearings, and the load may be turned in any direction without twisting the ropes and without twisting back. The hoist is made in five sizes with capacities ranging from 1000 to 10,000 pounds, using the ordinary air pressures.



A SMALL TRIMMING PRESS

A SMALL TRIMMING PRESS

The illustration shows a small press for trimming drop forgings. It is driven by a 2-horse-power electric motor, with the starting box within easy access of the operator. The press is mounted on a truck as shown, so that its range of action is only limited by the length of the feed wire. The total floor space occupied by the truck is 45x39 inches, the total hight is 84 inches, and the weight, including the truck, is 3000 pounds. The press is controlled by a positive clutch, operated by a hand lever. This press is made by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

A MULTIPLE-SPINDLE CORE-FORMING MACHINE

The Falls Rivet and Machine Company, Cuyahoga Falls, Ohio, has just brought out a multiple-spindle core-making machine in which the working parts are of hardened tool steel.

The machine makes six cores at a time. The makers guarantee a limit of accuracy of 0.002 inch in diameter. The dies are so made that they can readily be reground to size when they become worn. The machine is controlled by a cone clutch operated by foot trip with which the machine can be stopped the instant the sand ceases to feed.

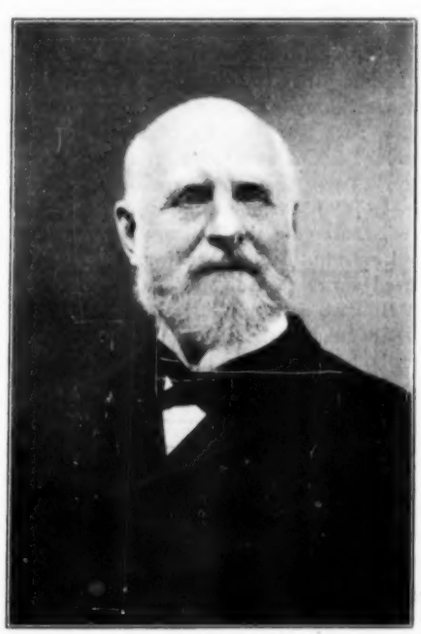
Edward P. Bullard

We have in a previous issue announced the death of Edward Payson Bullard, president of the Bullard Machine Tool Company, which occurred December 22, at Braidentown, Florida. For some years Mr. Bullard had been in poor health, and had laid the burdens of his large business upon the shoulders of younger men—chiefly his sons and a nephew; but when a few days before his death he left Bridgeport for Florida, he seemed as well as usual, and his death, which was due to heart trouble, was unexpected.

Mr. Bullard was born August 18, 1841, in Uxbridge, Massachusetts. After the completion of his apprenticeship to the machinists' trade at the Whitin Machine Works, Whitinsville, Mass., he went to work at Colt's Armory, in Hartford, Conn., where he remained until the latter part of 1863. He then entered the employ of Pratt & Whitney, working for them as a machinist until April, 1865.

At this time he formed the partnership of Bullard & Prest, carrying on a general machinists' business in the old county jail building, Hartford, on which site the Case, Lockwood & Brainard Company is now located.

In March, 1865, William Parsons was admitted to the partnership and the name changed to Bullard, Prest & Parsons. Mr. Prest withdrew early in 1866, and the firm became Bullard & Parsons. Vertical drill presses (one of which is now in use at the Bullard works) and pumps were the chief product of the firm.



EDWARD P. BULLARD

With the idea of moving the business to Norwalk, Conn., Mr. Bullard, in September, 1866, went to that city and interested a number of men in the project. The Norwalk Iron Works Company was or-

ganized for that purpose on October 5, 1866, with Mr. Bullard and Mr. Parsons as members of the board of directors. Changes in the plans were subsequently made, Messrs. Bullard and Parsons withdrawing and continuing their business at Hartford.

The depression of 1868 and lack of capital caused trouble for the firm. A reorganization was effected and they removed to Bristol, Conn., where Gray's foundry (established some years previously by Elisha N. Welch, later more famously known as a great clock-maker), now the site of the Sessions Foundry Company, was purchased by them and operated for a year, when the firm dissolved, and Mr. Bullard secured the position of superintendent of a large machine shop at Athens, Georgia.

There was at that time much bitterness of feeling against all Northerners, and on that account Mr. Bullard resigned his position and went to Cincinnati, Ohio, where he soon became known as a dealer in second-hand machinery. His first sale was of a large number of Lincoln milling machines, which he had found in an abandoned Confederate arsenal in Georgia.

He then connected himself with the Cincinnati branch of Post & Co., organizing their machine-tool department, which has since become the firm of E. A. Kinsey & Co.

Early in 1872 he went to Columbus, Ohio, to assume the position of general superintendent of the Gill car works, in that city. He left there in 1874, when the plant was closed down as a result of the panic of 1873; and for a short time he was superintendent of the Cooper Engine Works, at Mt. Vernon, Ohio.

Leaving there he established himself in the machinery business on Beekman street, New York City, in 1875, organizing Allis, Bullard & Co., at 14 Dey street, one year later. Mr. Allis withdrew in 1877 and the Bullard Machine Company was organized, continuing the business at the same address until 1880, when Mr. Bullard secured entire control and continued as E. P. Bullard, dealer.

Recognizing the demand for a high-grade lathe, in 1880 he went to Bridgeport, Conn., and engaged A. D. Laws to manufacture lathes of his design, agreeing to take the entire output of the plant. Owing to certain unsatisfactory features of the arrangement, Mr. Bullard, in the latter part of the same year, took over the business and styled it the Bridgeport Machine Tool Works, he being the sole owner.

In 1883 he designed his first vertical boring and turning mill, a single-head, belt-feed machine having a capacity of 37 inches. This was later sold to George A. Young, a manufacturer of paint-making machinery in Brooklyn, N. Y. This is believed to be the first machine of this type having such small capacity; boring and turning work of this size, having been done previously on the face-plate of a lathe.

In 1889 business in Bridgeport had increased to such an extent that he discontinued his New York connections and devoted his entire time to the development of the Bridgeport plant; J. J. McCabe, a member of Mr. Bullard's New York staff, establishing himself in the old warerooms.

The Bridgeport Machine Tool Works was incorporated in 1894 under the name of the Bullard Machine Tool Company, the ownership of stock being entirely in the hands of Mr. Bullard and his sons.

Though Mr. Bullard was a hard worker—had his full share of nervous energy, and did not spare himself—he yet got much enjoyment out of life chiefly because he was a practical philosopher, and able to apply his philosophy to his daily work. He did his own thinking, and was never afraid to take an advance step because no other had taken it.

Though possessed of great ability and good judgment as a designer of machine tools, and as a business man, he was unassuming, quiet in manner, always courteous and mindful of the rights of others, well read and intelligent about matters in general, as well as business affairs, and thoroughly to be relied upon.

He traveled much in Europe in the interest of his foreign trade, and had many friends there; and in whatever foreign country he traveled or sojourned, he was always the same quiet, unpretentious, thorough gentleman he was at home. Though a keen and energetic business man, he prized his honor above everything else. The world has too few men like him.

Obituary

James Thomas, president of the Davies & Thomas Company, Catasauqua, Penn., died December 18.

Abram R. Ludlow, for many years prominently identified with manufacturing industries in Springfield, Ohio, died there January 2 at the age of 80 years.

Business Items

In January 3 issue the name of the New York representative of the Warner & Swasey Company, Cleveland, O., was misspelled. It should have been H. L. Kinsley.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers. 75 Broad St., New York.

Caliper cat. free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Mechanical draftsman wishes drafting to do evenings at home. Box 424, AM. MACH.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Drafting, designing special machinery. Edward F. Chandler, 35 Frankfort St., New York.

Wanted—Catalogs and information regarding dove tailing machinery. Box 422, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACH.

Tool, die and press work. Experimental and model making; manufacturers of light machinery. C. B. Iserman & Co., Cushing Building, 20 Morris St., Jersey City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

Special tools, dies, jigs, fixtures and metal patterns; special and precision machinery; designing and experimenting; stamping and electro plating. The Soss Invisible Hinge Co., 797 Greenwich St., New York.

Wanted—Cleveland aut. screw mach. 1½" to 3"; Bardons & Oliver hand screw mach. 1¼" to 1½"; metal saw cut off mach. 16" to 24" saw; boring and turning mill 40" to 50". Box 413, AMERICAN MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Wanted—Two each new or second hand No. 2 plain milling machines with screw feed and No. 2 surface grinding machines as manufactured by Brown & Sharpe Manufacturing Company, or machines approximately equal. Lanston Monotype Machine Company, 1231 Callowhill St., Philadelphia, Pa.

A responsible German firm in Moskau (with the best connections in the technical trade) wishes to get the sole agency for Russia of high-grade American factories (motors, steam engines, water meters, naphtha meters, indicators, pumps, etc.) Applications and price lists, etc., to be addressed to "M. B." 17498 Moskau, General Post Office. P. O. Box 23.

Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 10 o'clock a.m., January 22, 1907, and publicly opened immediately thereafter, to furnish at the navy yard, New York, N. Y., and the naval coal depot, Bradford, R. I., as specified, a quantity of naval supplies, as follows: Sch. 327; 25 self-dumping steel cable cars, 2 hoisting engines. Applications for proposals should designate the schedule by number. Blank proposals will be furnished upon application to the navy pay office, New York, N. Y., or to the Bureau. F. B. Rogers, Paymaster-General U. S. N. 12-14-06.

Business Opportunities

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

Investment involving half ownership or more with any official position in old established iron works in important New York city is offered satisfactory young gentleman with $50,000 to $100,000; same required for working capital and improvements. Principal specialty absolutely staple. General engineering opportunities many. Particulars only upon suitable introduction financial and general. Positively no brokers. Address, "Iron Works," AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Astall Iron Works, machine-shop plant, established 40 years. Jesse Astall, Galveston, Texas.

For Sale—Two second-hand cupolas in first-class condition; shells 72"—82" in diameter and about 40 feet high. Box 333, AM. MACH.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classication indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Position as chief engineer; have first-class Mass. license; have been instructor in steam engineering; familiar with hydraulic and cross compound condensing and electric plants. Box 509, AMERICAN MACHINIST.

ILLINOIS

Mechanical engineer; technical graduate; 10 years' experience; specialty steam engines—practical erecting man; wants to change position. Box 429, AMER. MACH.
FOR SALE

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MARYLAND

Experienced draftsman, seeks position. Box 412, AMERICAN MACHINIST.

MASSACHUSETTS

Draftsman and designer, now employed, wishes to change. Accustomed to automatic and special machinery. Prefer Boston, or locality. Box 419, AMERICAN MACHINIST.

Machinist, toolmaker, designer of dies, jigs, fixtures, etc. Organizer, shop foreman, now superintendent, 14 years' general experience; good references and education; age 31. Box 431, AMERICAN MACHINIST.

MICHIGAN

Mechanical engineer, collegeman, desires a position as designer or assistant superintendent. Five years' drafting room and shop experience. Box 418, AMER. MACHINIST.

NEW JERSEY

Mechanical draftsman with two and one-half years' experience on engine, gages, jigs and calculating. Box 427, AMERICAN MACH.

Experienced designer on all classes of printing presses. Has had charge of work in large plant for a number of years. Address Box 414, AMERICAN MACHINIST.

Wanted—Position as superintendent, or general foreman in machine shop; sober man, up-to-date mechanic, knows how to handle men, and has 20 years' experience. Address Box 507, AMERICAN MACHINIST.

Position as superintendent, purchasing agent, or manager, thoroughly practical engineer, now holding responsible position. First-class references as to character, business and mechanical ability. Box 510, AM. MACH.

Position as advertising or sales manager by mechanical engineer with 12 years' experience in office, drafting room, shop, and selling. Has thorough mechanical training, knowledge of advertising, good command of English, and is a clear, concise correspondent. Is a high-grade man and will consider only first-class offer. Address Box 497, AM. MACH.

NEW YORK

Superintendent or master mechanic desires change; first-class references and experience on hard problems. Box 416, AMER. MACH.

Mechanical engineer; 25; university graduate; good theoretical knowledge and shop experience, desires position. Box 432, AM. M.

A graduated, and on steam engines well experienced mechanical draftsman desires a temporary position. Box 506, AMER. MACH.

Mechanical engineer, experienced designer on automobile, marine and stationary gasolene and oil engines, is open to engagement. Box 508, AMERICAN MACHINIST.

Position as foreman and designer by a tool and model maker, jigs, gauges, compound dies, etc. 20 years' experience. Box 411, AMERICAN MACHINIST.

General foreman of shops, age 37, master mechanic, varied experience, successfully producing high-grade work at lowest cost; natural executive. Box 402, AMER. MACH.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

Mechanical draftsman and designer wishes a change. Being married, wants a steady position with plenty of hard work, so that he cen use brain and experience; have a good education and experience, especially with special and mill machinery. Box 430, AM. M.

PENNSYLVANIA

Chief draftsman, general mill work, wishes position as chief draftsman or assistant superintendent. Box 417, AMERICAN MACH.

Position as superintendent, or general foreman, on steam pumps, air compressors, and machinery. Box 421, AMER. MACHINIST.

Wanted—Position as master mechanic or designing draftsman by a good practical man, holding similar position now, 10 years with present employer. Box 426, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Patternmaker as working foreman small shop in eastern city; state age, experience and pay expected. Address "Eastern," Care AMERICAN MACHINIST.

Machinists wanted—Lathe, drill press and bench hands, to work on tools and automatic machines, give full particulars. The Boesch Mfg. Co., Danbury, Conn.

Wanted—Good all-around machinists familiar with heavy work; steady work and good wages. Apply at once, Farrel Foundry & Machine Co., Ansonia, Conn.

ILLINOIS

Wanted—A man who has had experience making a general line of milling cutters, both solid and inserted tooth, carbon and high-speed steels. Steady work for good reliable man. Box 499, AMERICAN MACHINIST.

Wanted—An experienced superintendent for our plant at Aurora, Illinois. Must be familiar with power transmitting and conveying machinery. State age, experience, where employed at present and length of services in previous positions. All communications kept confidential. Address Stephens-Adamson Mfg. Co., Works, Aurora, Ill., or New York Office, 43 Exchange Place.

Wanted—Superintendent for light manufacturing plant making addressing and duplicating machines and supplies. New fireproof building having 50,000 ft. floor space. Present superintendent going in business for himself. Must be an expert on dies and jigs for manufacturing interchangeable parts and be fully competent to manage all kinds of help. Give age, experience, reference and salary expected. If desired applications will be kept confidential. Addressograph Co., Chicago, Il.

INDIANA

Wanted—Lathe men, tool makers, and machinists. Good wages; steady employment; increasing force. The Western Motor Co., Logansport, Ind.

Wanted—A draftsman; gas works apparatus and plants, by a contracting firm in Indiana. Tech. graduates of several years' shop or gas works experience preferred. Address "K," Care AMERICAN MACHINIST.

MASSACHUSETTS

Experienced mechanical draftsmen wanted for permanent position with General Electric Co., Lynn, Mass. Send full particulars regarding age, education, experience and salary expected to Engineer in Charge Drawing Office, General Electric Co., West Lynn, Mass.

Wanted—Foreman on high-grade automobile work; familiar with modern shop methods; capable of producing results and handling men; successful applicant must show experience in this line; state fully experience, give reference, age and salary expected. Location western Massachusetts. Address "S. P.," AMERICAN MACHINIST.

MICHIGAN

Foreman die and tool department—Wanted, a man capable of managing this department in a large factory in southern Michigan, manufacturing steel ranges, summer cook stoves, etc.; must be able to design and make all classes of forming, drawing, perforating and punching dies and special power tools; will also act as master mechanic for entire plant; successful applicant must show actual experience as foreman in this class of work; liberal salary for right man. Address Box 455, AMERICAN MACHINIST.

MISSOURI

Wanted—First-class assemblers; prefer those having had experience on adding machines or typewriters; give references. Universal Adding Machine Co., St. Louis, Mo.

Experienced superintendent, familiar with general sheet-metal work and fire-proof windows; take full charge of factory; permanent position for first-class man; state experience and salary wanted. Address H. W., AMERICAN MACHINIST.

NEW JERSEY

Wanted—Mechanical draftsmen on small tool and jig work; state age, experience, references and salary expected. Box 503, AM. M.

Wanted—Lathe, planer, vise and machine hands; good wages for first-class men. The Standard Motor Construction Co., 180 Whiton street, Jersey City, N. J.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Draftsmen—Large works requires competent men with experience on general engineering and construction work; preferably those who have worked on heavy special machinery, power plants, mill buildings, etc.; applications must state age, qualifications, initial salary and references. Box 487, AM. MACH.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

Wanted—A few first-class wood patternmakers. Snow Steam Pump Works, Buffalo, N. Y.

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co. Ilion, N. Y.

Wanted—Several first-class tool or die makers on small and medium blanking, forming, and drawing die work. Burdick & Son, Albany, N. Y.

Wanted—Designer on tools and equipment with shop and drafting experience. $20 per week. Adriance, Platt & Co., Poughkeepsie, N. Y.

Wanted—Draftsmen capable of designing tools for small interchangeable work. Write, giving experience, age and salary expected. Address: Box 434, AMERICAN MACHINIST.

Wanted—A number of first-class lathe, planer, slotter and boring mill hands, for both day and night shift. Steady work and good wages. Apply to Ingersoll-Rand Co., Tarrytown, N. Y.

Several mechanical draftsmen wanted; must have had at least 4 years' actual experience; good salaries to good men; give particulars; location New York City. Box 460, AMERICAN MACHINIST.

Wanted—Young man to handle orders and invoices, must be good writer and familiar with materials used in machine shop. State experience, give reference and state salary desired. Box 425, AMERICAN MACHINIST.

Wanted—Detail draftsman, one experienced in steam engine or air compressor design preferred; in answering give full particulars as to age, experience in detail and salary required. Box 428, AMER. MACHINIST.

Cummings Machine Co., 238 William St., 6th floor, are in need of lathe, planer, milling machine, boring mill, and general hands, accustomed to building machine tools and special machinery. First-class workmen only need apply.

A travelling salesman having practical machine shop experience to sell superior screw machine accessory. Good opportunity for proper person to advance. To receive attention, state age, experience and salary expected. "Mechanical," AMER. MACHINIST.

A concern in New York city wants a man widely experienced in handling men on hand and automatic screw machine work to take charge of its screw machine department. A high-grade man who can get results from men and machines will find this a good opening. Address Box 423, AMER. MACH.

OHIO

Wanted—First-class designing draftsman familiar with automatic machinery and power punches; steady postion to capable man. Box 388, AMERICAN MACHINIST.

Wanted—A first-class toolmaker who has had experience in experimental machine tool work and who is capable of perfecting uncompleted brass finishing tools. Write giving references and stating terms. Buckeye Iron and Brass Works, Dayton, O.

PENNSYLVANIA

Wanted—Good metal pattern makers. Steady work. Good wages. Address P. O. Box 515, Erie, Penn.

Wanted—General foreman for machine shop, employing 400 men, located in western Pennsylvania. Box 495, AMER. MACHINIST.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 433, AMERICAN MACHINIST.

Wanted—A draftsman with experience in designing jigs and fixtures for machine tools. State experience and salary desired. Box 496. AMERICAN MACHINIST.

Wanted—Instructors in mechanical and electrical engineering; technical graduates with some years' experience. Address Box 415, AMERICAN MACHINIST.

Mechanical draftsmen wanted for detail work with large mining company in western Pennsylvania; applicants must state age, experience, salary expected, and date for entering position. Box 472, AMERICAN MACH.

Wanted—Mechanical draftsman; young man with shop and drawing room experience (experience in paper mill machinery preferred). State age, experience, salary expected and give references. Box 493, AM. M.

Wanted—First-class machinists for floor work; must be capable of erecting machines outside the shop and demonstrating; state actual experience in such work. Apply to Stoever Foundry and Manufacturing Co., Myerstown, Pa.

Technical and experienced man wanted to fill position of chief mechanical draftsman with a large mining company in western Pennsylvania; state age, experience, salary expected and date for entering position. Box 473, AMERICAN MACHINIST.

RHODE ISLAND

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WASHINGTON, D. C.

Wanted—Ship draftsmen and assistant ship draftsmen. Pay from $5.04 to $2.00 per diem. For further information address "Commandant," Navy Yard, Washington, D. C.

WISCONSIN

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

FOREIGN

Wanted—A competent superintendent thoroughly familiar with the manufacture of special sewing machines with interchangeable parts of modern design. A permanent position is offered with one of the most important German sewing machine companies, in business 40 years, and employing 400 workmen. Applicants must have filled similar position in America, and must be either German, or have a thorough knowledge of the German language. Address giving full information as to age, qualifications, etc., to K. N. 3065, Rudolf Mosse, Köln am. Rhine, Germany.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Plate

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.

Bending Machines, Power

American Road Machine Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Machines, Hand

American Road Machine Co., Philadelphia, Pa.
Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nut and Screw

Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chains

See Hoists, Hand.

Blowers

American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Roth Bros. Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.
Keuffel & Esser Co., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery

Acme Machry. Co., Cleveland, O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Brown Co., H. B., Easthampton, Conn.

Bolt and Nut Machinery —*Continued.*

Detrick & Harvey Mach. Co., Baltimore, Md.
The Foote, Burt Co., Cleveland, O.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Machinery Co., Bowling Green, Ohio.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads

Lang Co., G. R., Meadville, Pa.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts

Dyson & Sons, Jos., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical

American School of Correspondence, Chicago, Ill.
Derry-Collard Co., New York.
Hill Publishing Co., New York.
Sames, C. M., Jersey City, N. J.
Wiley & Sons, Jno., New York.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. & Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring Bars

Elmes Eng. Wks., Chas. F., Chi-

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.

Boring and Drilling Machines, Horizontal —*Continued.*

Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb - Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co, Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Carr Bros., Syracuse, N. Y.
Fairbanks Co., Springfield, Ohio.

Brackets, Lamp

Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction

Electric Controller & Supply Co., Cleveland, O.

Bulldozers

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

Calipers
Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Wks., Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hopson & Chapin Mfg. Co., New London, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
National Mach. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks., Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Charts and Maps
Derry-Collard Co., New York.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Wks. Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.

Chucks, Drill—*Continued.*
Cushman Chuck Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co. Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Reed Co., Francis, Worcester, Mass.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
National Tool Co., Cleveland, O.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.

Clutches, Friction
American Tool & Mch. Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic
Sturtevant Co., B. F., Boston, Mass.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Leard, W. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.

Consulting Engineer
Thompson, Hugh L.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Correspondence Schools
See Schools, Correspondence.

Cost Systems
American Mechanical Calculator Co., Cincinnati, O.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., New Center, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., New Center, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., New Center, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Couplings, Shaft—*Continued.*
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes
Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nichols, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable
Nichols, Wm. S., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Leard, W. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuue, Iowa.
Becker - Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

"Whitney" Chains

In 1907 will break all previous records for durability

We are moving into our new fire-proof factory building and will operate both plants, old and new, until we are fully settled so our production may be steadily increased with no interruption.

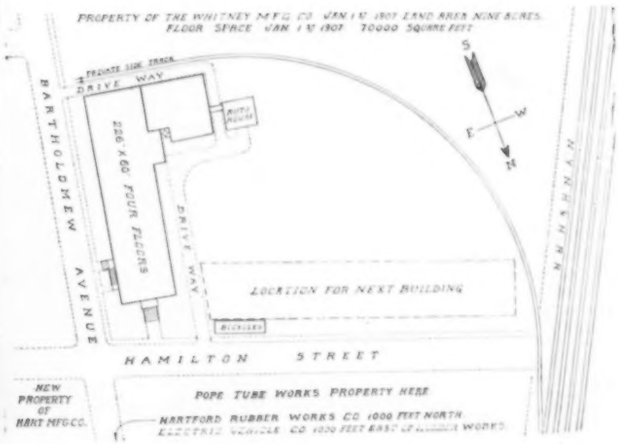
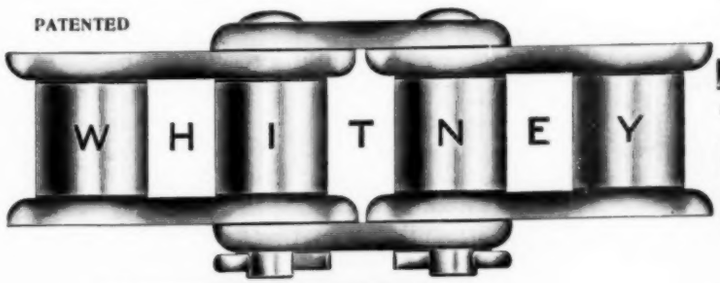
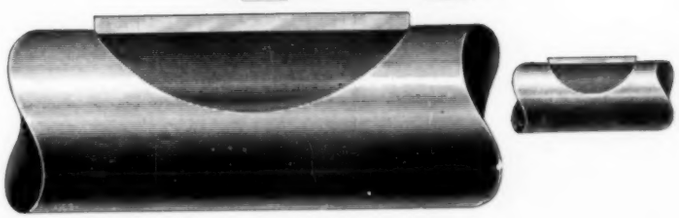

PROPERTY OF THE WHITNEY MFG. CO. JAN 1 '07 1907 LAND AREA NINE ACRES.
FLOOR SPACE JAN 1 '07 1907 70000 SQUARE FEET
PRIVATE SIDE TRACK
DRIVE WAY
226 X 60 FOUR FLOORS
BRICK HOUSE
BARTHOLOMEW AVENUE
DRIVE WAY
LOCATION FOR NEXT BUILDING
HAMILTON STREET
NEW PROPERTY OF HART MFG CO.
POPE TUBE WORKS PROPERTY HERE
HARTFORD RUBBER WORKS CO. 1000 FEET NORTH
N. HAVEN

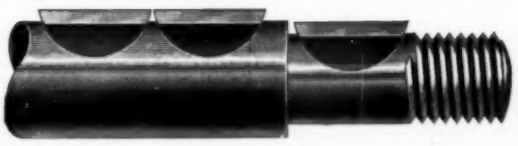
PHOTO. TAKEN NOVEMBER, 1906

This cut gives an idea only of the plant which we believe will be the finest and most complete in existence for the manufacture of High Grade Driving Chains.

PATENTED







"Whitney" Chains

HAND AND WEIGHT FEED MILLING MACHINES, and The Woodruff Patent System of Keying

are Standard with most American Builders of Automobiles, Commercial Cars, Machinery, etc.

The Whitney Mfg. Co.
Hartford Connecticut

Cutting-Off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers

Veeder Mfg. Co., Hartford, Conn.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos L., New York.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Kent & Co., Edw. R., Chicago, Ill.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, Conn.

Drawing Boards and Tables

Economy Drawing Table Co., Toledo, Ohio.
Keuffel & Esser Co., New York.
Rich, J. & G., Phila., Pa.

Drawing Materials

American Tracing Cloth Co., New York.
Derry-Collard Co., New York
Keuffel & Esser Co., New York.
Rich, J. & G., Phila., Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., B F., Rockford, Ill
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote, Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Drilling Machines, Multiple Spindle — *Continued.*

Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fichburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret

National Separator & Machine Co., Concord, N. H.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote, Burt & Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Murchey Machine & Tool Co., Detroit, Mich.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Robertson Mfg. Co., Buffalo, N.Y.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.

Drilling Machines, Upright — *Continued.*

Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jas. Jr. & Co., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, Ohio.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jas. Jr. & Co., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Electrically Driven Tools and Machinery — *Continued.*

Roth Bros. Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Heald Machine Co., Worcester, Mass
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room

Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances

Lunkenheimer Co., Cincinnati, O.

Engineers, Consulting, and Mechanical

Dodge & Day, Philadelphia, Pa.

Engineers, Electrical

Crocker - Wheeler Co., Ampere, N. J.

Engines, Automobile

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Atlas Engine Works, Indianapolis, Ind.
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Oil

Mietz, August, New York.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers

Bormay & Co., New York.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube

Nicholson & Co., Wm., Wilkesbarre, Pa.

Fans, Electric

Boston Blower Co., Hyde Park, Mass.
Crocker - Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

THE U. S. NAVAL GUN FACTORY AT WASHINGTON, D. C.—II

History Continued from the Civil War to the Present Time—Establishment of Modern Shops in 1886—An Era of Extensive Improvements and Great Activity—The Spanish War—The Output now Bigger than Ever

BY H. J. KENNEDY

On July 23, 1862, while still a Commander, Dahlgren was appointed Chief of the Bureau of Ordnance; but about twelve days afterward he was promoted to be Captain and his commission antedated, so that virtually he was of the rank of captain when he took charge of that bureau. His ability and valuable service in the improvement of ordnance were highly commended by the Secretary of the Navy. Captain Andrew A. Harwood then assumed command of the yard and the direction of the Potomac flotilla.

FIG. 9. COMMANDANT'S QUARTERS

INTERESTING INCIDENTS OF WAR TIME

Ericsson's little "Monitor," which made such a plucky fight against the ram "Merrimac," brought to the yard a problem very similar to that which the New York subway during the summer of 1905 forced upon the people of that city. It was found that, although her design was very efficient as regards protection from shot, her quarters were very inaccessible to air, and it was necessary to devise some means of ventilating them.

The Potomac flotilla had a hard time of it with the contraband vessels; for, in spite of all their efforts, a large amount of blockade-running went on. Besides the ordinary "contraband of war" many attempts were made at smuggling whisky across the river into Virginia. One vessel had on board 428 dozen cans of *eggnog*, entered on the manifest as milk, and the cans were labeled *"milk-drink."*

In 1863 Captain Harwood was made a commodore, his squadron being the Potomac flotilla. He must have been a busy man—running a ship-yard and gun factory and commanding a squadron all at the same time. At the end of 1863 he was succeeded by Commodore J. B. Montgomery.

FIG. 10. OFFICERS' QUARTERS

During 1863 no improvements were *completed* at the yard, but work was in progress, such as dredging channels, building a wall on the west side of the yard, increasing ordnance machinery and shops, and making repairs of all kinds. The copper-rolling mill was kept running night and day, but the amount of copper manufactured was not nearly sufficient to meet the demand. Recommendation was therefore made for an extension of the mill, also for an additional storehouse, marine railway and extension of the yard.

A good idea of the ordnance situation at that time is given by the following extracts from the official report of the acting chief of the bureau of ordnance in 1863:

"The introduction of a few rifled guns of heavy caliber into the batteries of ships had already taken place in foreign navies prior to the date of our present rebellion, and in our own service experiments were being conducted at the Washington navy yard, under the direction of Rear-Admiral Dahlgren, for the purpose of devising a system of rifling ordnance. Nothing decisive, however, has been accomplished, except with the rifle howitzers, and the experiments were rudely interrupted in the spring of 1861, owing to the difficulty of obtaining well seasoned timber for gun-carriages. Initiatory steps have been taken to introduce iron gun-carriages in lieu of wood for the heavy gun-batteries. For many years anterior to the war the Washington yard was the great depot from which the navy derived all its supplies of laboratory stores, fuses, boat howitzers, and shells. Since the rebellion,

however, the public necessities compelled the fabrication of howitzers elsewhere. The preparation of military fireworks, fuses, percussion caps, shrapnel, together with all howitzer ammunition, still remains exclusively with what is known as the 'ordnance-yard,' and the general character of the work there performed is too well known in all its manifold details to need more than a passing reference. In excellence of workmanship and promptness of execution, it still maintains the high reputation acquired under Rear-Admiral Dahlgren. It is also worthy of mention that from the laboratory of this yard alone the navy has been supplied with fuses, percussion caps, and military fireworks, as well as all the small-arms and cartridges not purchased from the manufacturers of special arms. While the work of keeping up a constant supply of ordnance stores has been increasing, the experiments with numberless inventions have never been interrupted. So also with the practice from the several batteries at armor plates and the proving of heavy guns and howitzers."

FIG. 11. WARRINGTON AVENUE, LOOKING WESTWARD; OFFICERS' QUARTERS ON RIGHT

THE NAVY YARD PREPARES FOR ATTACK

Up to 1864 the Confederates had been so much engaged in defending Richmond from assault, that there had been no aggressive movement upon their part, threatening Washington, since 1861. But in July, 1864, Uncle Sam's employees at the navy yard literally laid down the hammer of the mechanic to take up the gun of the soldier; at that time General Lee, in his endeavor to make General Grant relax his threatening grip on Petersburg and Richmond, sent General Jubal Early into Maryland, with an expedition which came right up to the fortifications outside of Washington. The authorities there were ready for him, however, and the navy yard played its part in furnishing men for its own and the capital's defense; guns were made ready and port-holes cut in the walls of the yard. General Early decided not to fight, and retired, enabling the workmen to resume once more their peaceful occupations. After this the commandant wanted permission to drill them one hour a day, but he did not succeed in obtaining it.

At this time carpenters of the first class were getting $3.50; boilermakers, $3.25; brass finishers and founders, $3.25; coppersmiths and tinsmiths, $3.25; iron founders, $3.25; machinists, first-class, $3.25, fourth-class, $2.50; blacksmiths, first-class, $3.50. These, of course, are merely a few of the large number of trades employed at the yard at that time.

END OF THE CIVIL WAR

At the close of the war in 1865 the Navy Department immediately sought to reduce its expenses, and reduction of force and all possible economy were enjoined on the commandant of the Washington navy yard.

THE STATUS OF THE ORDNANCE DEPARTMENT

During Rear-Admiral Dahlgren's attachment to the navy yard and ordnance bureau, the ordnance department of the yard was partially, and finally wholly, detached from the navy yard proper and was authorized to report directly to the Bureau of Ordnance. This independent relation continued up to September 1, 1866, when the ordnance establishment was re-attached to the navy yard by an order issued by Secretary Welles. The ordnance department of the yard was at this time in charge of Commander George Brown. In July, 1867, a change was made in the organization, giving to each bureau the immediate control of its own affairs, dividing the stores, which had all been in charge of the naval store-keeper, into four stores and apportioning the various workshops to different bureaus, instead of having all of them under the Bureau of Yards and Docks, as formerly.

In 1868 it would not appear that much work, comparatively speaking, was being done in the ordnance department; for, out of 891 employees at the yard, 203 were employed in steam engineering, 172 on construction and repairs, 238 on yards and docks, 200 on equipment, but only 71 on ordnance.

In 1869 the Navy Department sent word to the commandant that the U. S. naval hospital would be considered as attached to the command of the Washington navy yard. On April 21, 1869, the ordnance museum was ordered to be completed.

FIG. 12. SUPERINTENDENT'S QUARTERS

The work at this time appears to have been principally miscellaneous repair work, partly on monitors, tugs and other craft. In August, 1869, Rear-Admiral Dahlgren returned to the navy yard as commandant. He died, presumably of heart disease, on July 12, 1870. At this time there was apparently a renewal of activity in certain departments of the yard.

THE NAVY YARD BECOMING MORE INACCESSIBLE TO SHIPS

For some years the filling up of the eastern branch of the Potomac had been attracting attention, and at this time the ships were frequently running aground; but it did not seem possible to get Congress to do anything to relieve the conditions.

In 1881 the hydraulic-press house of the ordnance department was blown up by the explosion of a 6-inch rocket that was being prepared for service, which led to a recommendation that such work be done elsewhere than in the navy yard. In December, 1881, there were 42 officers on duty, including marine and warrant officers and excluding those attached to vessels. In 1883 a list was made up of eight brass guns, having an aggregate weight of about 8400 pounds, which had been captured in the war and which were to be sold to the Grand Army of the Republic to be cast into badges. In 1884 44 additional men were employed in the ordnance department to hasten the completion of work for the steel cruisers.

FIG. 13. COMMANDANT'S OFFICE

THE STEP WHICH LED TO THE ESTABLISHMENT OF WASHINGTON NAVY YARD AS A MODERN GUN FACTORY

For many years the Washington navy yard had been gradually declining in importance as a ship-yard, but this decline did not extend to the ordnance department. The latter at times made quite rapid advancement and showed signs of coming importance as a gun factory, though it suffered many setbacks from delay and inaction.

In 1883, under provision of a law of Congress, a gun-foundry board was appointed by the President. This commission visited the naval and ordnance works of Great Britain and Europe, and in the following year made a report in which they recommended the establishment of two Government gun factories for the manufacture of modern and heavy ordnance, one for the army and one for the navy, the latter to be at Washington. Congress gave favorable consideration to this report, but made no appropriations until 1885, when it apparently awoke to a realization of the helplessness of the country in case of war, and resolved to build a new navy composed of ships of war not inferior to those of other civilized nations, and to build suitable armor and armament for these vessels. The board was assured that American steel manufacturers would be willing to construct the necessary plants if certain of orders. As a result, Secretary of the Navy Wm. C. Whitney, in 1886, issued the following order:

"The demand for increased facilities for constructing the batteries for the armament of additional ships of war, which Congress has now provided for, makes it necessary to reassign the shops and buildings of the Washington navy yard. All the shops, machinery, tools, and appliances assigned for the use of the bureaus of construction and repair, steam engineering, yards and docks, and equipment and recruiting, are therefore to be turned over to the control of the bureau of ordnance, and the quarters now occupied by the representatives of the above named bureaus will be vacated on October 1, 1886." The board submitted a scheme for the construction of a gun factory for guns of calibers 6 inches to 16 inches, including shrinking-pit.

In accordance with this order work on the new establishment was begun in May, 1887. It should be noted that the construction of high-power, breech-loading, steel rifles had, however, been carried on before that time at the Washington navy yard with such facilities as the existing shops afforded, and the first 6-inch guns for the new navy were constructed there. The first one was completed in February, 1884, and was tested at the Annapolis proving ground. At first the work was carried on in the existing shops which had formerly been used for making anchors and chains and for building steam machinery; they were remodeled to adapt them to the new conditions, and supplied with the proper machinery, traveling cranes, etc. Ever since this time continual improvements have been made at the yard, including the erection of many new buildings and the enlargement and improvement of the old ones, the addition of much new machinery, the erection of a modern power plant, and the change of the shops to electric driving, as will appear in more detail later.

GETTING READY TO MAKE BIG GUNS—EXTENSIVE IMPROVEMENTS

The plan to make of the Washington navy yard a gun factory equal to those anywhere else evidently made the position of commandant there more important than it had been since the Civil War. The officer who then took command of the yard was Captain R. W. Meade, who in September, 1887, relieved Captain Wallace. The new commandant was able in 1888 to bring about an improvement of great benefit, consisting of the transfer to the navy yard of two acres of the United States Government reservation on the west side of the navy yard. Commandant Meade also put through other improvements, of which one was a proper system of telephone communication, and another was the installation of the electrical fire-alarm system and watchman's time-detector service. He also laid a railroad track in the yard, using a portion of the added area referred to above for this purpose. The yard tracks were connected with the Baltimore & Potomac Railroad, now known as the Philadelphia, Baltimore & Washington Railroad and forming part of the Pennsylvania Railroad system, which emerges from the tunnel on K street, two blocks north of the navy yard, on its way from Baltimore to the Pennsylvania's old station in Washington. A contract was made with the Brush Company for the installation of an electric-lighting system, the generating plant having been located in the center of the (Smith) quadrangle.

It will be seen that this was a period when the navy yard was rapidly assuming the characteristics of a modern manufacturing establishment. Captain Meade's policy was apparently the introduction of "business" methods rather than "quarter-deck" methods. An illustration of this spirit is an order which he issued upon the subject of uniform, in which it was stated that the force in the yard was divided into two classes; the purely military and the civilian; that a man engaged in performing functions belonging to the former class should wear military uniform; an officer on duty in the workshops should wear either service uniform (without side arms) or civilian dress, according

to the nature of the work, but that no combination of the two would be permitted.

In October, 1889, the following employees were on the pay roll: Yards and docks, 83; construction, etc., 84; steam engineering, 15; equipment, etc., 2; ordnance, 861; pay office, 5; general store-keeper's department, 17; medicine and surgery, 2; total, 1069. The amount of the pay roll, which also includes the officers of the yard, and some retired officers, was for the month of September, 1889, $140,000.

For the new gun factory it was decided to utilize the large building that had formerly been a forge and anchor shop, and to equip it for the manufacture of six-inch and eight-inch guns; while immediately adjoining its north end a new and large building was to be erected for finishing guns of the largest sizes. The floor of the forge and anchor shop was to be lowered, the roof raised six feet, and a 40-ton traveling crane introduced, running the whole length of the shop. In the large building, a 110-ton traveling crane was to be installed, and a shrinking-pit for all classes of guns was to be located at the south end. The large shop immediately adjoining to the west was to be fitted up as a carriage and projectile shop, and to be equipped with a 25-ton traveling crane. The other buildings on the west side of the yard were to be utilized, some as foundry and finishing shops for small parts, and others as carpenter, pattern shops, etc. The following was the estimated capacity of the completed factory, ordinary working time: Six-inch guns, 25; eight-inch, 4; ten-inch, 6; twelve-inch, 4, or a proportionate number of any given assortment of calibers.

Work on the alterations was begun in May, 1887. The clearing out of the forge and anchor shop, and digging out the old foundation and pipe connections under the floor, which was found to be an exceedingly laborious task, were among the first tasks completed. The laying of the foundations for the 40-ton crane supports and the excavation for the foundation of the large gun shop were well advanced in the same year.

The cost of these improvements was estimated as follows:

Anchor shop (8-inch gun shop) now south gun shop	$76,184.00
Twelve-inch gun shop (now north gun shop)	130,403.38
Gun-carriage shop	50,740.81
	$257,328.19
Add 10 per cent. for contingencies	25,732.81
	$283,061.00

In 1888 it was found that, because of quicksand, excavating for a shrinking-pit was a difficult job and a greater expense was incurred than was expected. The difficulty was, however, surmounted and the work progressed slowly, but satisfactorily. Ten 6-inch guns, as well as others, were made at the Washington navy yard during this time.

It is recorded that, in 1889, the enlargement, extension and equipment of the main ordnance building was nearly completed, and additional office buildings were being constructed, so that within a year or two more there would be at Washington a gun plant capable of turning out breech-loading rifles of 16-inch caliber and weighing 110 tons, 47 feet long, projectiles weighing one ton, range 10 miles, powder charge 1000 pounds.

WASHINGTON ABLE TO HANDLE ALL CONTRACTS IN 1890

In 1890 it was announced that no further contracts for the manufacture of heavy guns would be made with private firms, as the capacity of the gun factory in Washington was sufficient to handle forgings as fast as they should be received.

The ill-fated "Maine" was the first ship of her size built in one of our navy yards (the Brooklyn yard), and in this year work was going on at the Washington yard on her 10-inch guns.

The improvements at the gun factory during the year included the erection of a 110-ton overhead traveling crane, the completion of the shrinkage-pit, gun-carriage shop and office building, the construction of a siding from the Baltimore & Potomac Railroad, and addition to the mechanical equipment of the yard. An electric plant having been installed for lighting the shops and streets, it was even at that time considered that it could be economically utilized in electrically driving the machinery in the day time.

One of the things which forcibly strikes the visitor to a war ship or navy yard is the great amount of money which it is necessary, under modern conditions, to expend upon the armament of a nation. Nevertheless, it is exceedingly instructive to note what a tremendous reduction was made in the cost of ordnance when the Government ceased contracting with private firms for this work, and instead did it itself in its own factory. Taking, for example, the 8-inch gun, we find that under the old contract the Government paid $8500 a gun, whereas in 1888 the average cost of these guns, excluding the cost of forging, when made at Washington, was $5163, and in 1890 it was reduced to $2772, the average time of manufacture in ten-hour days, being 225 in 1888, and 120 in 1890.

FIG. 14. LAWN IN REAR OF COMMANDANT'S OFFICE, SHOWING OLD GUNS AND BOATHOUSE

1891

The progress in the development of the plant in 1891, which was regarded as very satisfactory, included the completion and putting in operation of the 110-ton crane; and the erection of a new fast-traveling 15-ton crane in the gun shop on the 40-ton crane supports, which were extended through the north gun shop to increase handling facilities. The galleries of the gun shop were equipped with machine tools for small work and foundations were built for the large gun lathes contracted for with William Sellers & Co. The bureau of ordnance purchased from Bement, Miles & Company, a second large lathe suitable for 8- and 10-inch guns; and purchased and installed a large amount of machinery for the manufacture of the breech mechanism, mounts, etc., for the rapid-fire guns.

Eighty-three machines were added to the shops during this year. The furnace for producing hot air in the shrinkage-pit for expanding forgings was constructed, thus enabling the work to be kept free from flame and the products of combustion. The new office building was completed and occupied; the chemical laboratory established and its work found valuable. The gun-carriage shop, projectile shop, mount shop, tool room, breech-mechanism shop, experimental shop, foundry and forge shop, pattern shop and copper-rolling mills were all busy. Experiments were made on treating armor-plate by the "Harvey" process.

ALL THE BIG GUN LATHES INSTALLED BY 1892

In 1892, Secretary Tracy considered the Washington gun factory had become one of the best equipped in the world, with a capacity of manufacture equal to that of many of the foremost establishments of Europe. By this time all eight of the heavy gun lathes were installed in the north gun shop, these being machines Nos. 1 to 8, to be illustrated and described in the section on the gun shop. A rifling machine for heavy guns was completed and put in operation, and improvements on the breech-mechanism shop were commenced. It was recommended that the forge shop, which at that time occupied the southwest corner of the quadrangle, should be evacuated to relieve the crowded condition of the gun-carriage and projectile shops.

DISPENSING WITH HYDRAULIC POWER AN IMPROVEMENT

It is in most cases considered an advance when, in the operation of machinery, hand power is replaced by some other source of power. However, along about this period we find an example of a change, which, though constituting an improvement, goes in just the opposite direction. Hydraulic power in the operation of the gun mounts was dispensed with, the improved mechanism permitting of the operation of the mount by hand power, reducing the amount of apparatus liable to injury, and also effecting a reduction in the weight which the ship must carry for each gun.

In 1892, it was estimated that the capacity of the Washington gun factory was two each of 16-inch, 13-inch, and 12-inch guns, twelve 10-inch, and twenty-five 8-inch guns; or ten 13-inch, twelve 10-inch, and twenty-five 8-inch guns per annum; or four 13-inch, four 12-inch, twelve 10-inch, and thirty-five 6-inch guns per annum.

THE WORK ACCOMPLISHED UP TO 1893

During 1893 the Washington gun factory continued to render a good account of itself, the gun shops being very busy on the guns for the new ships, and up to November in this year, there had been completed 237 guns ranging in caliber from 4-inch to 13-inch. The new gun lathes reduced the labor cost of the machining of a large gun by more than 30 per cent. The largest guns being built were 13-inch, foreign experience with guns as large as 16.75 inches caliber not making them seem to be very desirable for naval use. The great advantage of the more moderate sized gun is the fact that it can be operated by hand power. The improved hand-working breech mechanism was adopted for all guns from eight inches upward.

The breech-mechanism shop was completed, and work continued on the removal of the forge shop, and the extension of the mount shop.

1895 AND 1896

In 1895, in view of the approaching completion of the guns for the new ships, and in order to retain men who had acquired valuable experience in the construction of guns, the bureau of ordnance recommended that Congress make appropriation for making guns for reserve and for the auxiliary cruisers.

The fitting of the new forge shops was completed in December, 1894, and in April, 1895, the old shop was in operation as a gun-carriage shop. The working force was reduced on account of the diminution of the amount of work on hand.

During 1896 alterations on the foundry were in progress, and also improvements at the northwest corner of the gun-carriage shop. The average monthly working force was 820.

THE CENTRAL ELECTRIC POWER STATION AND THE CARTRIDGE-CASE PLANT FORECASTED IN 1897

On June 1, 1897, Commander O'Neill was superseded as superintendent of the naval gun factory by Commander E. C. Pendleton.

Secretary Long called attention to the wasteful system of supplying power to the shops in the navy yards by a number of boilers and engines scattered through the works at different points, and he recommended the use of electric power generated in a central power station.

One hundred and forty two reserve guns were in process of manufacture. The foundry was raised in hight and given a new roof, and was equipped with new cupolas, blowers, cranes, air furnaces, etc. Improvements were made to the west gun-carriage shop. It was recommended that the Department should add to the plant at the gun factory a branch for manufacturing brass cases for fixed ammunition, instead of following the expensive practice of purchasing them. Experiments were continued on an 8-inch nickel-steel gun which had been under construction for some years.

1898—WAR AGAIN MAKES HUSTLING TIMES AT THE NAVY YARD

During this year the new navy got a chance to try its efficiency in actual warfare, with results that are well known. Because of the war the Government shops had to work continuously at the production of war material; during the year 112 guns of various calibers from 4-inch to 13-inch were completed at the naval gun factory, twelve of these being 13-inch, one 12-inch and twenty-nine 6-inch.

FIG. 15. COMPLETED SLIDES FOR 12-INCH GUNS, PAINTED AND LETTERED READY FOR SHIPMENT; PATTERN SHOP AND FORGE SHOP IN BACKGROUND

New designs were prepared for guns with increased muzzle energy.

The naval gun factory, until the outbreak of the war, was engaged upon the current work of manufacturing the guns, mounts and outfits for new vessels, etc., carrying on its work at the rate of eight hours per day; but when war became imminent it was operated continuously, sending out guns, mounts and equipments for auxiliary vessels, and pushing to completion the batteries for the new vessels, such rapid progress being made that there was no delay to the auxiliary vessels on account of lack of armament. The shops, however, were much overcrowded. A storehouse for guns was built, and some improvements in the erecting and gun-carriage shops and elsewhere were made. Preparations were made to convert the copper-rolling mill into a cartridge-case shop.

A large amount of work on sights was done, and numerous accessories were

furnished for the ships, auxiliary cruisers, etc.

The following figures regarding a very few of the miscellaneous articles manufactured will give an idea of the amount of work which was done: 81,930 cartridge bags, 35,448 ammunition boxes, 10,272 four-inch shell caps, 2156 thirteen-inch shell caps, 9010 ammunition chests, 42,825 base fuses, 286,500 wads of all calibers. Over 40,000 packages, weighing over 4,000,000 pounds, were shipped during the year.

ADDITIONAL SHOPS BUILT IN 1899

During 1899 the navy yard was still in charge of Commander E. C. Pendleton, who planned and executed many important improvements. A new machine shop, equipped with the best machinery and operated by electricity, was completed and put in service on miscellaneous work, such as mounts for small guns, torpedo-launching apparatus, etc. The old breech-mechanism shop, having become unsafe, was abandoned, and in its stead the gun-shop building was extended 250 feet south. The north end of the same building was also extended 47 feet to give additional floor space for heavy guns under the 100-ton crane. The cartridge-making machinery was installed, though the work on the building was not completed. The erecting shop was remodeled, and steel galleries, electric cranes and other machinery were put in. The storehouse for the storage of guns and mounts was completed and put into use. Improvements were made in other shops also. In the forge shop was installed a set of hammers for making drop forgings, and gas made on the premises from oil was substituted here for coal as fuel.

Four 13-inch guns were completed, another nearly completed, one 12-inch 40-caliber gun partly assembled, four 8-inch guns completed, two nickel-steel guns assembled, and smaller guns also made. The amount of miscellaneous articles manufactured did not differ much from that of the previous year.

IMPROVEMENTS CONTINUED IN 1900

On March 31, 1900, Commander E. C. Pendleton having completed a term of three years' duty was detached and ordered to sea, and he was relieved by Commander E. H. C. Leutze, U. S. N. The improvement and development of the gun factory during Commander Pendleton's term of service far exceeded that of any previous period of equal length. The average monthly force during 1899-1900 was 1667 men.

Extension to the north end of the gun shop was completed; an additional 15-ton overhead electric traveling crane was installed in the south gun shop. The cartridge-case shop was completed and put in operation in January, 1900, cartridge cases, in size from one-pounder to 6-inch guns being manufactured. The old tool shop was torn down and a new one commenced on the same site, and a new gunners' workshop commenced. The new storehouse for guns was doubled in length, filling a long-felt want, and various other improvements were made.

Though a large amount of work was done in the gun factory during the year, the showing of completed guns was not great, because many were held up in order to develop details of the breech mechanism.

IN 1901, NAVAL ORDNANCE WAS GETTING PRETTY WELL SETTLED DOWN TO PRESENT STANDARDS

No important developments in armor or naval ordnance took place during this year, but improvements were made in the details of gun mechanisms, and in sights, mountings and equipments. No material change was made in the system of gun construction followed for some years, except that provision was made for future guns of 6-inch caliber and over to have an inner and outer tube or barrel instead of a solid forging as heretofore used, in order to increase the factor of safety of the chase and muzzle of the gun.

The latest types of guns being so great in weight and dimensions it now seemed inadvisable to make any further increase in either respect, and increased efficiency must be looked for in the use of heavier projectiles, and in the production of powder possessing higher ballistic properties.

MOUNTS WITH TWO RECOIL CYLINDERS INSTEAD OF FOUR

Instead of the mount with two recoil cylinders above and two below the gun, plans were made for a new type of mount for the 12-inch 40-caliber guns with but two recoil cylinders, placed under the gun where they are safer and more accessible, besides reducing the size of port opening necessary in the armor. In Fig. 15 can be seen some of these slides, which, it is evident, are big enough for a man to be comfortably seated within them. They are steel castings bushed with bronze, and having flanges at the front to which plates of armor are attached. The one in the foreground is for a 12-inch gun, mark V, mod. II, for the forward turret of the U. S. S. "Idaho." The one in the background is for a similar gun in the after turret of the U. S. S. "Mississippi." The one in the middle is a 12-inch type mount of a somewhat earlier design. When the gun is in place, the two piston rods extending backward out of the recoil cylinders pass through the lugs on the yoke which is fixed on the breech of the gun, and the backward movement of the gun when fired pulls back the pistons, the rapidity of the motion being reduced by the mixture of water and glycerin, which must flow around the pistons in grooves from the back ends to the front ends of the cylinders. The gun is returned to its normal position by springs, the fluid in the cylinders checking the counter-recoil also.

USE OF TELESCOPE SIGHTS

All guns of 4-inch caliber and larger were now supplied with telescope sights in addition to open-bar sights. The telescope, though a great convenience under favorable conditions, has the disadvantage of the liability of the lenses being clouded by moisture, smoke, etc., and the difficulty of getting the target in the field of view again when lost, as is likely to happen, for instance, in a rough sea. However, the simpler open-bar sight is provided right alongside of it ready for service in such an event.

Work at the naval gun factory was carried on continuously, the principal machines being kept running two and even three shifts of eight hours each in the twenty-four.

Since the date of the previous report, 143 guns were completed, including eight 12-inch 40-caliber guns, one 7-inch 45-caliber, twenty-five 6-inch 50-caliber, etc.

Guns of all calibers from 1 to 13 inches, with mountings and equipments, were in process of manufacture. Fifty-two seamen were under instruction. Cartridge cases to the number of 98,960 were manufactured, most of them being one-pounder. Of the remainder, 4390 were four-inch, and 710 were six-inch. The new tool shop was completed, and other shop improvements made. The gunners' workshop was completed and a miscellaneous shop started. From July 1, 1900, to June 30, 1901, over 9,500,000 pounds weight of manufactured articles was shipped from the yard. On July 1, 1901, 2061 persons were employed, which was 191 more than during the busiest time in the Spanish-American war. The ordnance exhibit for the Pan-American Exposition was prepared.

The bureau of medicine and surgery in this year reported that the flats on the Anacostia river continued to exert a strong influence on the health of the yard, though the percentage of malarial cases had steadily decreased since 1895.

THE OUTPUT IN 1902

In 1902 the gun factory was running on full time, the more important machines running on double time, with two shifts of men, the average number of employees being 2115. During the year 233 guns, chiefly of large caliber, were manufactured at the naval gun factory. No changes were made in gun construction, except that the tubes of all guns of six inches and over were now reinforced to the muzzle. The length and weight of guns increased, which, together with the use of smokeless power, resulted in a great increase in energy.

Since the manufacture of modern guns was begun at the Washington navy yard, 1210 guns of various calibers had been completed up to that time and 281 were then in process of manufacture.

During the fiscal year ending June 30, 1902, the expenditure for labor at the bu-

reau of ordnance at the Washington navy yard was over $1,746,000, being greater than for any preceding year.

Captain Leutze was sent to sea, and on October 15, 1902, the yard was again put in charge of Captain E. C. Pendleton.

THE GUN FACTORY BEING WORKED TO THE LIMIT IN 1903

Secretary Moody has stated that it requires practically as much time to manufacture the armament of a battleship as to build the vessel. The demand for guns for the new naval vessels during this year taxed the productive capacity of the navy yard, two and sometimes three shifts of men being employed, and the principal tools being in operation day and night. We find that now the main battery guns for the battleships and armored cruisers are being made of nickel steel and are double tubed; that is, the jacket extends to the muzzle.

During the fiscal year ending June 30, 1903, one 13-inch breech-loading rifle, 35-caliber, was completed, and twelve 12-inch, two 8-inch, and several others smaller, making a total of 150. The new steel plant produced castings amounting to nearly 109,000 pounds. The average number of men employed was 2440. The drafting room, in spite of having 18 draftsmen, could not begin to keep up with the work demanded, much of which was original design of a high order.

The new building for the gunners' storehouse was practically finished, and the new coppersmiths' shop almost completed. The miscellaneous shop was completed and much machinery installed. The foundry was overcrowded with work. In the forge shop a trimming press for trimming drop forgings was installed, and a machine for bending and shrinking tires on field-carriage wheels, and other improvements were made. A large amount of unfinished work was left on hand partly because of numerous changes in the designs of elevating and training gears and in the sights.

1904—OTHER SHOPS HAD TO HELP OUT ON THE WORK

During 1904, in addition to the Washington factory, the Watervliet arsenal, and the Bethlehem and the Midvale Steel companies took part in the construction of naval guns. The problem of improving the sights and methods of mounting them continued to be persistently attacked, with the result of still further increasing the congestion of work at the Washington factory, so that relief was sought by letting contracts for sight mountings to several private firms, some of whose methods have been already illustrated and described in the AMERICAN MACHINIST.

CHANGE OF THE GUN LATHES TO ELECTRIC DRIVE

During this year, work on the new boiler house and electrical power house was under way; the lathes in the north gun shop were changed from belt drive to electric drive, and other improvements were made. Two hundred and eighteen guns were completed, including eleven 12-inch, nineteen 8-inch, two 7-inch, fifty-seven 6-inch, etc. The steel-casting plant produced over 918,000 pounds of work. The drafting force was increased to 26, and the output much improved over the preceding year.

1905

The gun factory, under Captain E. C. Pendleton, continued to be worked at its full capacity day and night during 1905, and even then could only keep up with part of the ordnance construction on hand, so that some of it was done outside. Some improvements were made in the navy yard, including the installation of 10 new boilers, with mechanical stokers, economizers, exterior superheaters, etc., in the new boiler house, and coal-conveying appliances.

1906

During the fiscal year ending in 1906, the output of guns, mounts, and accessories reached the highest amount for any one year in the history of the gun factory; the amount was increased nearly 50 per cent., and the expenses reduced, by some changes in the system of management, and by speeding up the machinery, and using new jigs and new labor-saving machinery. The aggregate weight of all the shipments from the yard, not including material shipped to and from the naval proving ground, was 20,611,127 pounds.

Among the improvements which are worth mentioning here are the installation in the boiler house of the new power plant of the third set of five Babcock & Wilcox boilers, with Wilkinson stokers, Green economizers, and Foster superheaters. In the west gun-carriage shop was installed a large Bement-Miles boring mill for boring and turning trunnions for 8-, 10-, and 12-inch mounts; and two of smaller size were put in the east gun-carriage shop. In the west gun-carriage shop was also installed a special Pratt & Whitney machine for grinding ball races for 6-, 8-, and 10-inch mounts. Several additions were made to the equipment of the forge shop, including a 3500-pound Bement-Miles steam drop hammer.

With a view to effecting a saving by the introduction of fuel oil to supersede the present Acme oil gas system, experiments were made during the year with the burning of oil, with results that appear very promising.

The navy yard was in charge of Captain E. H. C. Leutze.

Having now brought this historical sketch up to date, we will take up in the next article, the construction of naval guns.

The motor used by M. Santos Dumont in his recent successful attempt to fly with an aëroplane weighed slightly over 2 pounds per horse-power.

Why Should There Be Industria Insurance?

We believe that the cost of industrial insurance management could be cut down considerably, as a great deal of it is apparently due to the predominance of the shareholders' interest over the policyholders' interest in the conduct of the business. It is the shareholders' interest to increase the new business as much as possible at the expense of the existing policyholders, in order to increase thereby the aggregate profits available for distribution. It is the policyholders' interest, on the other hand, not to increase the new business more than is necessary to make good the losses caused by death, lapses and so forth. The industrial companies have been doing much more than this, with the result that the policyholder has not only to pay for his own insurance, but for the labor involved in convincing his neighbors, Tom, Dick and Harry, to insure also. And this procedure is justified on the argument made famous by Mr. McCurdy, that insurance is a missionary enterprise and no one ought to complain so long as the cause of thrift is promoted.

To the student of social economy the question will probably occur, What should we do if there were no industrial insurance? Would the country be any worse off if the poorer classes, instead of paying this enormous sum of $845,000,000 to the insurance companies during 29 years had kept it in their pockets?—Harold Seymour in *Moody's Magazine* for January.

Rate of Pay for Machinists Increased during 1906 Eight Million Dollars Per Annum

Regarded from the standpoint of wages and continuity of employment, the year 1906 was a good one for machinists, according to fourth Vice-President Wilson of the International Association of Machinists, who is reported to have said recently:

"Advances in wages have been received by 115,000 machinists throughout the country this year without strikes, which will aggregate $8,000,000 a year in wage advances. The advances were principally on the part of the railroad companies, but there has been a general tendency to advance wages. The Northern Pacific Railway advanced the wages of the machinists 25 cents a day; the Southern Pacific 2½ to 4 cents an hour; the Rock Island 30 cents a day; the Southern Railway 1½ to 2 cents an hour; the Harriman lines 30 cents a day, and the Great Northern 25 cents a day. The year 1906 has shown more advances and fewer strikes than any other year, and has been generally prosperous."

THE SAW-TOOTH ROOF IN FACTORY-ROOF CONSTRUCTION—I*

BY FRED S. HINDS

Before Dr. Cartwright invented the power loom in 1785, the cotton-spinning factories had attained quite a considerable growth in the Lancashire district of England. When the cotton loom came into practical use, weaving was carried on in the homes of operatives, up to the time when, with the increase in cotton weaving and the advent of the power loom, it developed upon the progressive operator to branch out into a new plant and set up a few power looms, as a weaving establishment. This naturally was a one-story building, and in time was designated as a "weave shed." Thus was commenced a system in textile manufacture which became popular, and is so today in England and on the continent. The spinning factory produces the yarn and the weave shed the cloth.

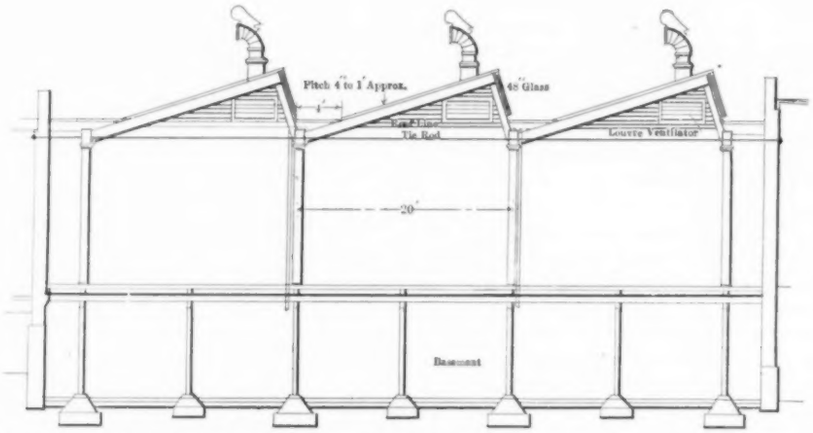


FIG. 1. STANDARD SAW-TOOTH SKYLIGHT IN MILL CONSTRUCTION, OVER A DEPARTMENT OF THE FIBERLOID COMPANY'S PLANT, INDIAN ORCHARD, MASS.

Note the Flat Roof Between Skylight and Ventilators

As these weaving companies changed from plain to fancy and colored weaving, and increased the width of the weave sheds to gain greater area, some method of roof lighting became necessary. Thus necessity, the mother of invention, produced the saw-tooth form of roof skylights for lighting the center of the wide one-story buildings. The English and continental manufacturers were not long in appreciating the value of this method of lighting. The first use was on machine shops making cotton machinery. Today they are found on all kinds of manufacturing plants.

The principle in this so called "saw-tooth" form of skylight is the focusing of a strong north light upon the work in process. This is secured by the greenhouse type of sash, applied to one side of the saw-tooth and exposed to the north light, the glass being set at such an angle as not to admit the direct rays of the sun. This type of sash reduces to a minimum the wood work, and thus minimizes the obstruction of light and the casting of shadows. The result is a practically continuous window of glass, which gives a far greater lighting area than wall and windows, or than skylights placed in the usual manner at intervals.

The skylights may run across the building, or lengthwise of the building, so that the glass may face to the north. Placed across the building, they are somewhat simpler in construction and thus less expensive.

METHOD OF CONSTRUCTION

Today there are two constructive designs in applying these skylights; one English and the other American. The English design is in the true form of saw-tooth; the American, in the modified form, or semi-saw-tooth flat-roof design. The English design was Americanized by the writer, as shown by the accompanying illustrations and photographs, to meet the conditions of our rigorous and changing climate.

In 1885, when associated with a mill architect and engineer, the writer was called upon to design some method of roof lighting on a one-story addition to be built in a mill-yard area formed by three buildings in the shape of the letter U. The problem was to light this area and project light into the first story of the then existing buildings so as to make up for the loss of light due to roofing over the yard area. This same year the writer happened upon an English type of saw-tooth lighted weave shed in connection with a mill plant in the same neighborhood. Upon examination it was found to be giving trouble from leaks. In this type of roof the acute angle formed by the two sides of the skylight was finished in the form of a gutter, made up of sheet metal. These gutters fill up with snow and water, which, melting and freezing, cause excessive expansion and contraction, and the result is cracks and broken joints.

The writer, profiting from this experience, designed a semi-saw-tooth flat roof. In this type the space between the skylights was finished in the usual gravel roofing, the slant of the roof conveying the roof water to the end of the skylight, where it enters the gutter.

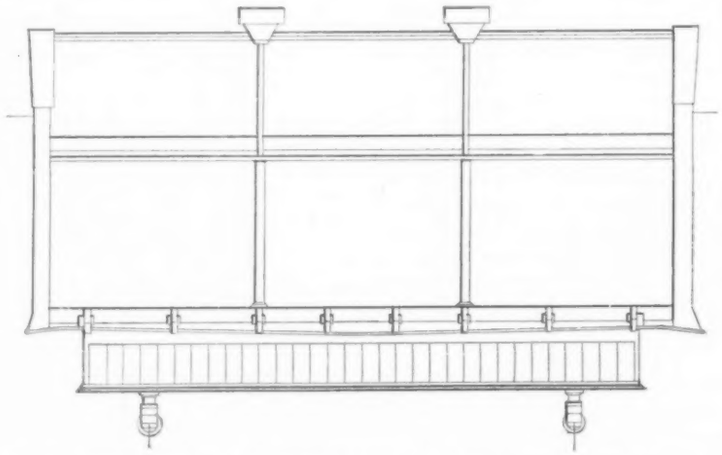


FIG. 2. FRONT VIEW OF SAW-TOOTH SKYLIGHT, FIBERLOID COMPANY'S PLANT

ANGLE OF THE GLASS

The angle of the glass is designed by some at 60 degrees, but when the sun is in the zenith it will shine through these skylights. This matter has been lost sight of, as one of the leading features in the principle of saw-tooth skylights is the elimination of the direct rays. For the South the writer has used 77 degrees and for the North 71 degrees.

In my later designs I have reduced the wide flat roof space between the skylights, and somewhat reversed the modification, returning more closely to the English system, but at the same time preserving a

*Extracts from a paper read at the December meeting of the American Society of Mechanical Engineers.

narrow flat roof between the skylights, varying in width from 24 to 48 inches, according to circumstances. (See Figs. 1, 2 and 3.) The flat gravel roof was then reduced from ½-inch to ¼-inch pitch to the foot, in order to convey the water away in the usual manner, and avoid the building up of such high forms as would be necessary with ½-inch pitch.

The hight of the glass is based entirely on the class of manufacture and amount of light required. Four, five and six feet have been my usual basis to work from in determining the size to use. Four feet high, every 20 feet, is good for general use. Five feet is used for special cases, such as high erecting shops, and six feet for cases where extra strong light is required.

In the year 1900 the writer was called upon to design, in connection with the planning of a Southern cotton factory, the weave shed for weaving pattern fabrics. In adopting the saw-tooth skylight I had to eliminate all cross timbers to avoid the casting of shadows. Appreciating the value of north light, and wishing to avoid any direct sun rays, I set the sash at an angle of 77 degrees. This angle, which brings the sash only 13 degrees from the vertical and therefore not at a great inclination, led to the belief that the elaborate trussed form in framing these skylights was entirely unnecessary to resist this small amount of thrust. I therefore adopted the tie-rod as the lower chord spanning from column to column, anchoring at each end wall.

LATEST SKYLIGHT DESIGN

Fig. 3 illustrates the various details of my latest skylight design, and it will be noted that both the double glazing and single glazing are represented. I would draw particular attention to the details of the metal bars. The bars and the bottom of the glass are provided with small gutters for collecting any condensation, and openings are provided in the horizontal metal for letting out the water as it collects.

The double glazing is necessary for some manufacturing plants in the North, but only single glazing is used in the South. The flat gravel space between the skylights and the method of flashing are also detailed.

One element of weakness in the construction of some roofs of this type is that the galvanized iron is continued down onto the roof and becomes a part of the flashing. True flashing, and the best, should be of about 10-ounce zinc, running up behind the counter-flashing, or outer flashing, of the skylight.

Fig. 3 also shows the slat walk which it is wise to provide in Northern skylights, not only to walk upon, but also to facilitate the shoveling off of snow without destroying the gravel roofing.

DEALING WITH SNOW

This leads to the subject of snow and the question whether it makes the use of skylights inadvisable. As the prevailing winds in snow-storms are either from the northeast or northwest, it is found to be true (according to observations in a locality in Massachusetts where this style of skylight is very popular) that the wind in a high storm will blow the snow out, because of the somewhat funnel or grooved shape of the skylights. However, suppose they do fill up somewhat with snow, it is not a great expense to hire cheap labor to shovel out this snow, as through our whole winter period heavy storms are only occasional. The cost of shoveling out the snow is a very small expense as compared with the enhanced value that fine lighting gives to the production of a plant. It must be conceded that with a monitor skylight in a drifting storm, the vertical side would resist the snow and pile it up, and naturally bring about the same result as with the saw-tooth. Right here the English system would show its serious defect. The advantage of the flat roof is that it spreads out the saw-tooth into a wider area and the snow cannot pile so deep as in the "V" form.

ELABORATE TRUSSING UNNECESSARY

Fig. 4 illustrates the elaborate trussed form of framing, Fig. 5 a similar form in reinforced concrete. I believe it is entirely unwarranted, as it increases expense in construction and becomes an obstruction to its own light. Fig. 5 shows two very weak points. First, you will note at *A* that the tin roofing forming the gutter, or flat valley, runs up under the slag or gravel roofing, as you would flash under a slate roof. This is at a vertical wall. The same criticism applies at the gutter formed by the skylight itself, or at *B*.

It is well known in building construction that the worst form of gutter is to have the slant of a roof strike up against a vertical wall where a gutter, or flat valley, must be constructed to carry away the roof water. It makes a very acute angle in which snow and water can collect. The water is taken up by capillary attraction and percolates through some

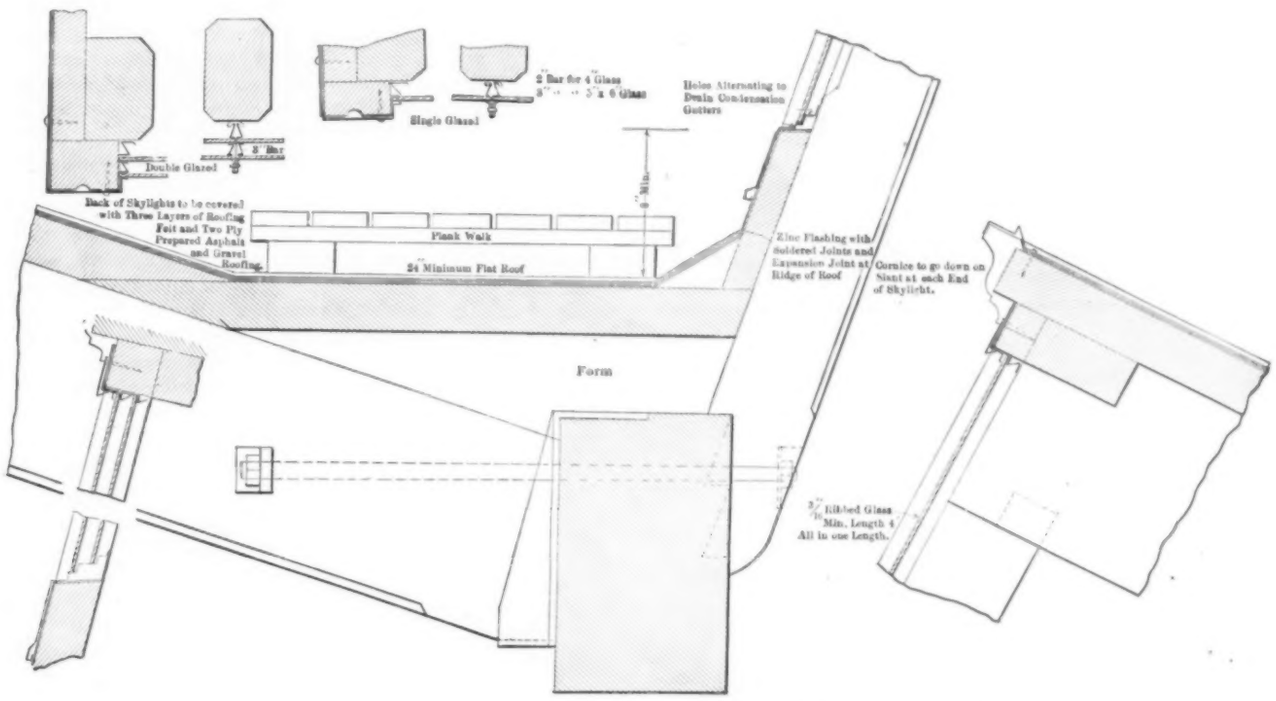

Single Glazed
Holes Alternating to Drain Condensation Gutters
Double Glazed
Back of Skylights to be covered with Three Layers of Roofing Felt and Two Ply Prepared Asphalt and Gravel Roofing
Plank Walk
24 Minimum Flat Roof
Zinc Flashing with Soldered Joints and Expansion Joint at Ridge of Roof
Cornice to go down on Slant at each End of Skylight.
Form
Ribbed Glass
Min. Length 4
All in one Length.

FIG. 3. DETAIL OF AMERICANIZED SAW-TOOTH SKYLIGHT FOR FACTORY ROOFS

crack in the roofing higher up than the highest point of the tin-work that runs up under the gravel roofing.

VERTICAL SASH

Some designs have the sash set vertically. This is uncalled for, as, with the same hight of glass, if the sash is set at an angle, the area of direct rays of light is increased. There is also less length of slant for the back of the skylight, and thus less roof area to cover. This vertical design was used for the purpose of hanging the sash with weights or on a pivot. The slant from the vertical is so small that there is no trouble from the weather beating in.

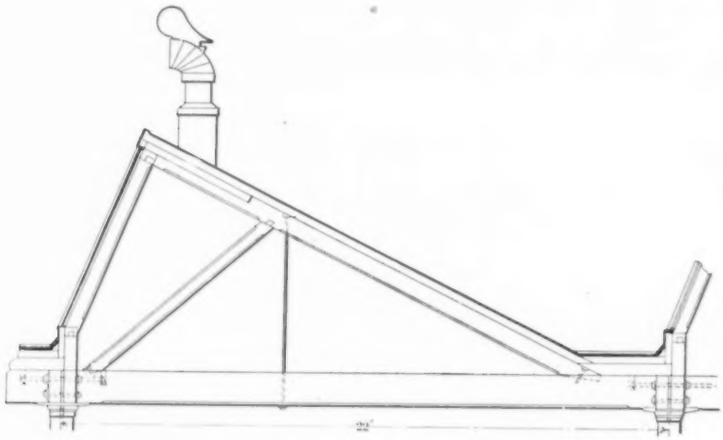


FIG. 4. ELABORATE TRUSSED FORM OF SAW-TOOTH SKYLIGHT

SASH CONSTRUCTION

The sashes are constructed either of wood or sheet metal. If of wood, the glazing is with putty; if of metal, the glazing is done without putty and bars are formed to take care of condensation. With reference to wood *versus* metal skylights, and what metal workers are doing under contract at the present time, the following is a quotation from a letter on the subject: "We have a contract at present for changing over four saw-tooth skylights, about 200 feet long by 15 feet glass opening, from wood construction to metal construction; also for two saw-tooth skylights that we are erecting in metal. These are about 90 feet long by 10 feet 6 inches glass measure. Heretofore the saw-tooth skylights for this company have been built in wood and a departure was made in favor of metal."

VENTILATION

The subject of ventilation, in connection with this particular class of skylight, has gone through changes along with the vicissitudes of the skylight itself. When these skylights were first introduced on weave sheds of cotton factories, no ventilation was provided. Later, as the skylight manufacturers developed new inventions, the Louvre ventilator was adopted and used in the end of the saw-teeth, as a substitute for round windows, which may have been hung on swivels. Next followed the usual style of galvanized iron ventilator, common in metal skylights used on other classes of buildings. The latest method is to hang one-half the length of the glass at the top and control by the usual quadrant for opening at any angle. These are good in periods of clear weather, and in connection with the roof ventilators give a very good current of air. In stormy weather these side lights must be closed, and the ventilation is taken care of by the Louvre and the roof ventilators.

ROOFING

The most approved practice for covering the back of these skylights is some form of asphalt roofing, the method of applying depending upon the angle, or slant, of the roof. Those which have a slant of 4 inches to 1 foot can be covered with the usual asphalt felt roofing and covered with gravel, the same as a flat roof. If the slant is greater, then the two upper layers of felt should be applied in what is called prepared gravel asphalt roofing. The flat spaces between the skylights can be of the usual coal tar, felt roofing, and gravel, unless one prefers to have it all asphalt at a slightly increased cost.

Saw-tooth skylights do not add to the architectural beauty of a factory building, and therefore I have studied to keep them down to a reasonable hight, and at the same time make them high enough to give the amount of light required.

REINFORCED CONCRETE

The use of reinforced concrete in factory buildings suggests its adaptability to saw-tooth skylight construction. Fig. 6 illustrates how this Americanized saw-tooth form can be very simply constructed in reinforced concrete and embody in it all the features necessary.

APPLICATION

Saw-tooth skylight construction is not only adapted to cotton factories but to factory buildings, machine shops and for all kinds of manufacturing plants, where better lighting is required than can be obtained from side windows. It is superseding the common monitor roof, and is especially adapted for use over erecting rooms and crane rooms of machine shops. It solves the problem of the one-story flat-roof machine shop and factories, where this style of construction is desirable and wide buildings are required. In shop economics, and with the extensive area of modern plants, the monitor skylight compels an excessive length in buildings, while the saw-tooth skylight admits of a proportionally greater width and less length, hence giving a more compact arrangement of the shop departments and a consequently greater available area of floor space.

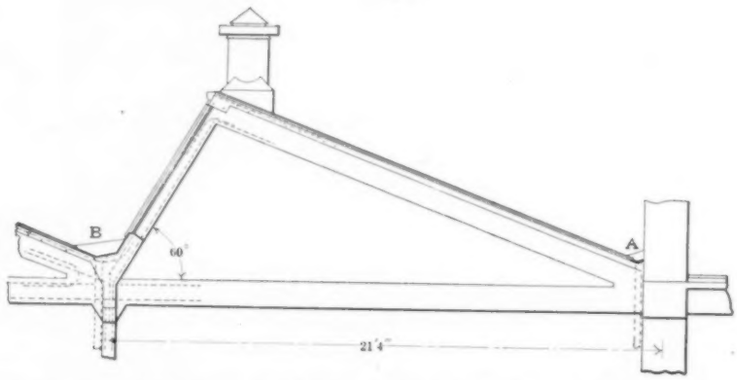


FIG. 5. SAW-TOOTH SKYLIGHT IN REINFORCED CONCRETE, WITH HEAVY CONCRETE BEAMS AS BOTTOM CHORD OF TRUSS

Where land is valuable, it is applicable to the two-story shop or factory, if special provision is made for lighting the first story. My latest application to a machine shop was a design for the John Thomson Press Company, of an 80-foot shop erected at Long Island City, in 1905, while I was acting as consulting architect. This width of 80 feet had two rows of columns, thus practically three 25-foot divisions.

The manufacturer's general plan was to use the two outer divisions of first story for heavy tools, the center division for tool room, storage, etc., and the second

story for light machine tools. Over this second story, the introduction of the saw-tooth skylight is applicable and very practical. Its practical value is in the improved arrangement of tools and benches. Instead of the benches being run around the room against the walls, they can be run across the room, benches and tools alternating down the length of the shop, according to the nature of the product.

above line has been made by Willard T. Hatch, a member of the society, in the treatment of foundry roofs, where he has placed the glass skylights on one side only of the successive ridges of the roof, and used the continuous ventilating monitors at the peak of the ridges as a screen to keep direct sunlight off the glass, thus making the angle of the glass with the vertical much greater than would otherwise be possible, at the same time getting the benefit of the brighter light of the upper sky in much greater degree than would be the case were the same area of glass placed more nearly vertical.

equator, there will be a little direct sunlight on the windows for a little while after 6 a.m., and also for a little while before 6 p.m., solar time being used in the reckoning. Mill hours in the North usually begin about 6:30 a.m. and end about 6 to 6:15 p.m., or, in other words, the help work a greater number of hours after mid-day than before it, and where the compass points of the building are not already determined by other considerations, we can avoid in a large measure the direct light of the late afternoon sun in summer by placing the building so that the saw-teeth will face from 5 to 15 degrees east of north, and still not have trouble from direct sunlight before bell-time in the morning.

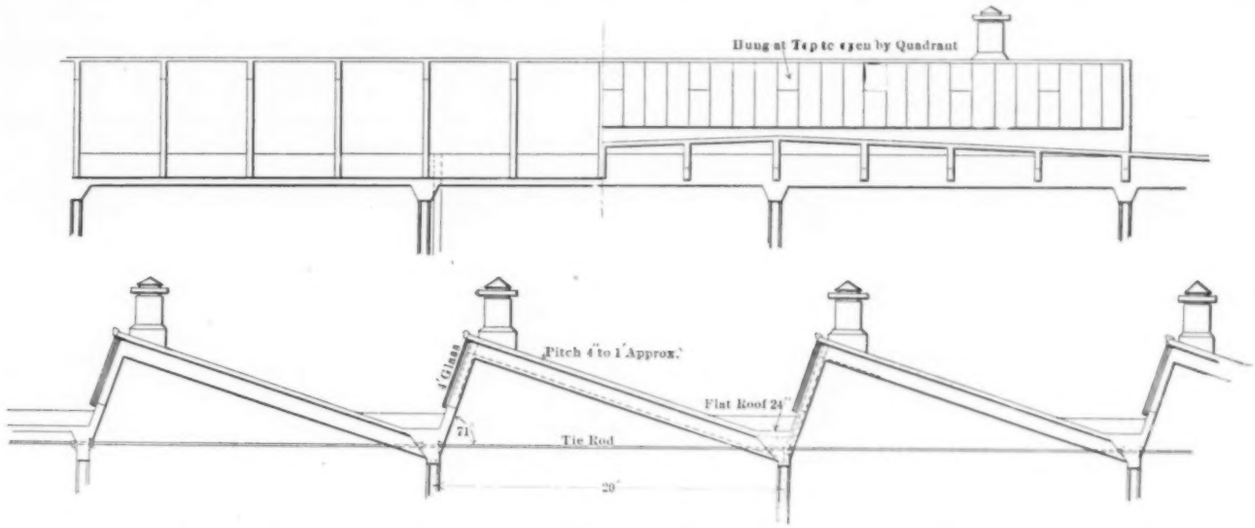


FIG. 6. SAW-TOOTH SKYLIGHT IN REINFORCED CONCRETE, WITH THE BOTTOM CHORD OF TRUSSED FORM SIMPLY A TIE-ROD AT THE COLUMN LINE

With this system a greater production is sure to follow and with the strong roof light, a higher degree of workmanship.

From a paper on the same subject read at the same meeting by K. C. Richmond, we extract the following:

ANGLE OF THE GLASS

The purpose of the saw-tooth form of lighting being, in most cases, to provide direct skylight in large quantity, and at the same time to avoid direct sunlight as far as possible, it follows that north of the tropics the saw-tooth windows must face nearly north, and the angle of the sash with the vertical be made dependent on the latitude of the location, the angle increasing the farther north we go. In the latitude of New York, about 41 degrees, this would mean an angle of only 17 to 18 degrees, to keep out the sun in the longest summer days, were it not for the small projecting cornice above the window, and the internal stool or gutter at the bottom. These projections enable us to make the angle of the glass with the vertical greater than we otherwise could do, and with the form of setting and trimming frequently adopted, angles from 25 to 30 degrees have proved satisfactory in practice in New York and New England. The angle of the glass with the vertical could be made much greater, and still keep out direct sunlight, if the cornice above the windows were extended, or a screen or barrier run along the crests of the saw-teeth. A very interesting modification of saw-tooth lighting on the

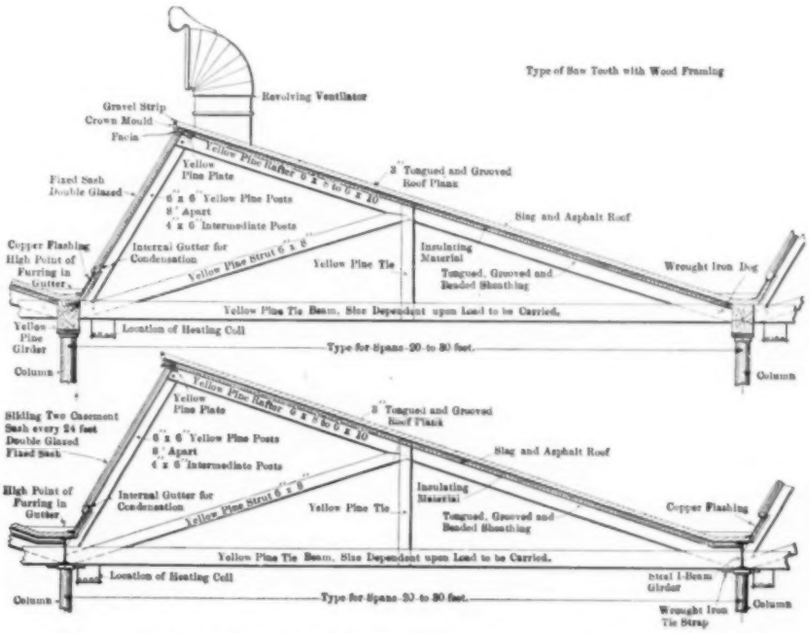

Type of Saw Tooth with Wood Framing
Revolving Ventilator
Gravel Strip
Crown Mould
Facia
Yellow Pine Plate
Fixed Sash Double Glazed
6 x 6" Yellow Pine Posts 8' Apart
4 x 6" Intermediate Posts
3" Tongued and Grooved Roof Plank
Slag and Asphalt Roof
Copper Flashing
High Point of Furring in Gutter
Internal Gutter for Condensation
Yellow Pine Strut 6" x 8"
Yellow Pine Tie
Insulating Material
Tongued, Grooved and Beaded Sheathing
Wrought Iron Dog
Yellow Pine Tie Beam, Size Dependent upon Load to be Carried.
Location of Heating Coil
Type for Spans 20 to 30 feet.
Yellow Pine Girder
Column
Sibling Two Casement Sash every 24 feet Double Glazed Fixed Sash
Steel I-Beam Girder
Wrought Iron Tie Strap

FIG. 7. TYPES OF WOOD-FRAMED SAW-TEETH FOR SPANS FROM 20 TO 30 FEET

Where the angle of the glass with the vertical is made greater than a theoretical consideration of the latitude permits, for the reasons above noted, and the windows face the north, it follows that at seasons when the sun rises and sets north of the

FLASHING AND DRAINING

The flashing and draining of saw-tooth roofs have given trouble at times. The

great length of flashing in the valleys between the saw-teeth gives opportunity for much expansion and contraction, and the piling up of snow in the valleys, with a relatively warm roof melting it on the underside, gives a chance for water to work up over the lower flashing, unless the same is of ample hight and very carefully put in, and provision is made for promptly carrying off the water from the melting snow. Where the saw-teeth run across the building, the roof is often pitched from the center ridge to both sides on a slope of a quarter to a half inch per foot, and the water carried off in conductors which run down on the inside or the outside of the outside walls. Outside conductors have proved very undesirable in New England on account of the water freezing as soon as it has passed from the warm surface of the roof to the cold outside conductor. The result is a great mass of ice and generally a broken conductor. It is altogether desirable, in climates where water freezes in the winter, to run the conductors down on the inner face of the side walls and to make both the strainers and conductors of ample capacity to carry off any probable amount of rain or melted snow.

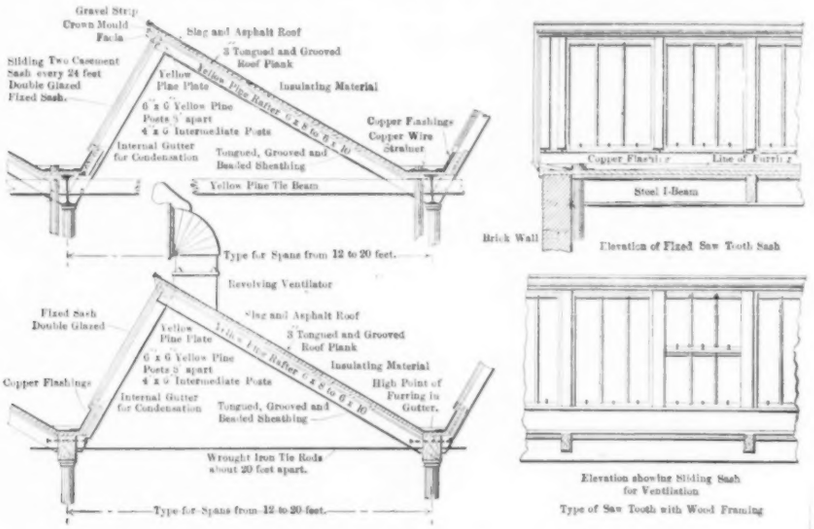

Gravel Strip
Crown Mould
Facia
Slag and Asphalt Roof
3 Tongued and Grooved Roof Plank
Sliding Two Casement Sash every 24 feet Double Glazed Fixed Sash.
Yellow Pine Plate
Insulating Material
6 x 6 Yellow Pine Posts 8' apart
4 x 6 Intermediate Posts
Copper Flashings
Copper Wire Strainer
Internal Gutter for Condensation
Tongued, Grooved and Beaded Sheathing
Yellow Pine Tie Beam
Type for Spans from 12 to 20 feet.
Revolving Ventilator
Fixed Sash Double Glazed
Yellow Pine Plate
3 Tongued and Grooved Roof Plank
6 x 6 Yellow Pine Posts 8' apart
Insulating Material
4 x 6 Intermediate Posts
Copper Flashings
High Point of Furring in Gutter.
Internal Gutter for Condensation
Tongued, Grooved and Beaded Sheathing
Wrought Iron Tie Rods about 20 feet apart.
Type for Spans from 12 to 20 feet.
Copper Flashing
Line of Furring
Steel I-Beam
Brick Wall
Elevation of Fixed Saw Tooth Sash
Elevation showing Sliding Sash for Ventilation
Type of Saw Tooth with Wood Framing

FIG. 8. TYPES OF WOOD-FRAMED SAW-TEETH FOR SPANS FROM 12 TO 20 FEET

Where the ridges of the saw-teeth run with the length of the building, water can be most conveniently removed from the valleys by conductors placed at intervals of 40 to 60 feet apart in the valleys. Experience in New England seems to show that a 3-inch conductor so placed is amply sufficient to take care of 1000 to 1200 square feet of roof surface, providing the conductor has a free downward run of 12 or 15 feet. A slight pitch of the bottom of the valley toward the conductor opening in the roof is easily effected by furring up the roof under the roof covering. In a roof recently built from the writer's design a pitch of 3 inches in 20 feet proved amply sufficient to remove all the water from the bottoms of the valleys. The conductors, after coming through the roof, can be connected into a larger pipe near the roof or be carried down through the room and be disposed of in the basement. The strainer on the roof often fits into a roof thimble made tight with the roof covering, and the thimble runs down into the conductor pipe proper. The connection of the roof thimble with the top of the conductor is frequently a slip joint, made by slipping the thimble some 12 inches down into the conductor, and when the pipe connecting the conductors is near the ceiling, and only slightly pitched, there is danger in very heavy rains of its filling, and of the water backing up and overflowing between the roof thimble and the top of the conductor, unless the connecting pipe is made of very ample proportions. I think it is better to carry the conductors down to and through the floor and gain the effect of the head in the vertical pipe to rapidly discharge the water. The conductors themselves should be of stout construction, where they come down through the room, and ordinary wrought-iron pipe has been found a satisfactory material. Cast-iron soil pipe is liable to be broken, and the sheet-metal conductors of commerce are sure to be bent and dented in factory service. When columns are of iron pipe, or of hollow cast iron, they can be readily utilized for roof conductors; and where the columns are not used for conductors, the conductors can be run in line with the columns without wasting valuable floor space. The writer's feeling is that it would generally be better to make the plane of the roof level, even when the saw-teeth run across the building. This brings the girders carrying the saw-teeth all on a level and the room is of uniform hight under the girders, which in some measure simplifies the installation of machinery and shafting. Where there is no overhead shafting, a difference of a few feet in the hight of the roof at different points may make no difference in the value of the room as working space, and it is cheaper to drain the roof by a few large conductors at the ends of the valleys at the outside walls than by a system of small conductors at intervals, as described.

PROPORTIONS OF SAW-TEETH

The proper proportioning of the saw-tooth light is important to obtain the best results without wasting money in their erection. Some saw-tooth roofs have been designed with the span of the saw-tooth very short in relation to the hight, thus making the backs of the saw-teeth very steep, and the valleys sharp and narrow. The result seems to be some loss of light, on account of the obstruction formed by the backs of the saw-teeth themselves, and there is an unnecessary

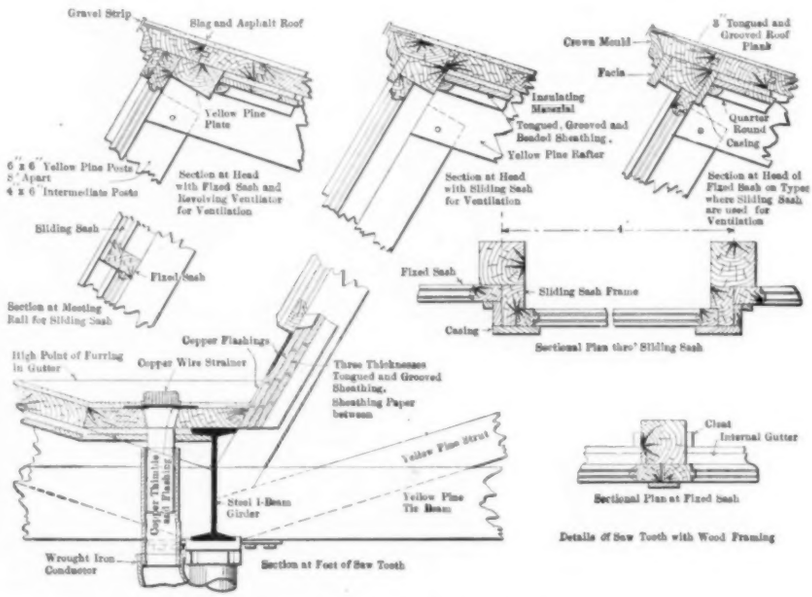

Gravel Strip
Slag and Asphalt Roof
Yellow Pine Plate
6 x 6 Yellow Pine Posts 8' Apart
4 x 6 Intermediate Posts
Section at Head with Fixed Sash and Revolving Ventilator for Ventilation
Insulating Material
Tongued, Grooved and Beaded Sheathing.
Yellow Pine Rafter
Section at Head with Sliding Sash for Ventilation
Crown Mould
Facia
3 Tongued and Grooved Roof Plank
Quarter Round
Casing
Section at Head of Fixed Sash on Types where Sliding Sash are used for Ventilation
Sliding Sash
Fixed Sash
Section at Meeting Rail for Sliding Sash
Fixed Sash
Sliding Sash Frame
Casing
Sectional Plan thro' Sliding Sash
Copper Flashings
High Point of Furring in Gutter
Copper Wire Strainer
Three Thicknesses Tongued and Grooved Sheathing, Sheathing Paper between
Yellow Pine Strut
Copper Thimble and Flashing
Steel I-Beam Girder
Yellow Pine Tie Beam
Wrought Iron Conductor
Section at Foot of Saw Tooth
Cleat
Internal Gutter
Sectional Plan at Fixed Sash
Details of Saw Tooth with Wood Framing

FIG. 9. TYPICAL DETAILS OF WOOD-FRAMED SAW-TEETH

expense for glass and flashings, as fewer saw-teeth with longer spans, or the same number of saw-teeth with shorter windows, would give all the light needed. The experience of the writer after an examination of the lighting effect in a very considerable number of saw-tooth lighted rooms, designed by different engineers, is that to obtain the best results there should be no intervals between the saw-teeth. A flat place on the roof generally means a shadow, even if slight, or perhaps only a less brightly lighted area, and makes a break in the otherwise almost perfect diffusion of the light. By the same reasoning, the obstruction caused by the necessary space and flashings below the windows and by the supporting girders carrying the saw-tooth frames should be kept at a minimum. With attention paid to these points, a proportion of hight of window to length of span of the saw-tooth, in the ratio of 1 to 3½, or 4, gives all the light desirable in this climate; and if this ratio is exceeded I think it is at the expense of greater first cost for glass, and a greater running cost for heating, although special conditions may make the proportions given unsuited to a given case.

DETAILS OF WOOD FRAMING

The three sheets of drawings (Figs. 7, 8 and 9) show types of saw-teeth framed in wood, with some details which the writer believes meet the requirements of this latitude. Very little originality is claimed for these, as they are the result of experience gained in the examination of many different roofs designed by many different men, combined with the statements of those who have used the roofs, and the experience of the writer's personal practice in trying to overcome some of the troubles which have been noticed or reported. Many of the members can doubtless suggest forms and details which they have used, and which meet conditions better than anything noted, and it is from these that the writer hopes to hear.

From the discussion of these papers we extract the following. Professor Sweet said:

I am led to comment on Mr. Hinds' paper more to correct some mistakes than with an idea of adding much to its value.

In 1889 the weaving-shed roof of the Straight Line Engine Company's Works, in Syracuse, was built, and I supposed at the time and until the appearance of Mr. Hinds' paper that it was the first application in this country of this form of roof to machine-shop use. As a full account of this roof was given on pp. 527 to 535 of the *Transactions* for 1893, I have only to add that it is on the English plan and without the troubles Mr. Hinds mentions, and these were obviated by making the gutters of cast iron, short enough to go between the trusses, which are only 8-feet centers, and by draining each trough by a separate spout into a continuous conductor running from end to end of the building. As the troughs and conductors are inside the building and are of iron instead of wood, they melt out the snow and ice before it melts on the roof, and hence there is no trouble from freezing ice and snow. The troughs being in sections with a proper joint cover, expansion and contraction have no detrimental effect. So satisfactory have been our 17 years of experience, that the same system has been adopted for the artisan school.

The spans are 32-feet trusses 8 feet apart, and the glass 6 feet high. During the 17 winters, snow has never had to be shoveled off but once, and then only because it piled up on the glass and shut out the light. In the ordinary machine shop the lower chord of the truss, in addition to acting as a chord, has another function to perform, that of carrying the line shaft and counters and two angles spaced 5/8 or 3/4 inch apart, between which supporting bolts will pass, making a far more convenient arrangement than to screw coach screws into the wood girders. Concrete for this service would appear to be especially bad where shafting has to be supported. With our experience I would be as reluctant to adopt the other form as Mr. Hinds would be to adopt ours. Any kind of metal gutters if properly made, will work all right if inside the building.

It is common practice to put trusses 16 to 20 or more feet apart with purlins from truss to truss, then rafters and planking. Light trusses, eight or at most ten feet apart, are better for several reasons. The purlins and rafters are dispensed with, two light trusses have less to carry than the one heavy one, they are more easily constructed and erected, and with the close spacing they are right for line-shaft hangers without stringers.

It is claimed by the constructors of structural-steel buildings that the large trusses and wider spacings are cheaper and constitute the better method, but they can be just as easily mistaken as anyone else. At least for spans of 30 or 40 feet, I am satisfied that when considering the advantages pointed out above they are dead wrong.

Certain manufacturers of agricultural implements, who are large buyers of iron and steel, have forwarded to President Roosevelt a petition which relates to the tariff on iron and steel. In this petition these manufacturers make certain statements regarding the restriction of the market and their inability to buy under free and competitive conditions, whereupon our contemporary, the *Iron Trade Review*, informs these manufacturers to the effect that they know little or nothing of what they are talking about, and it concludes its article by saying that "the petition shows either gross ignorance or wilful intention to mislead." Very pleasant language to apply to manufacturers who have simply expressed their views as to a public matter affecting their interests!

Legal Notes

BY E. F. BUFFET

CAN LICENSEE TO SELL PATENTED ARTICLE RESTRICT PRICE?—WHO IS A MANUFACTURER?

An opinion on a commercial question relating to patents, which is said never to have been decided before, has been handed down by the U. S. Circuit Court for the Eastern District of Pennsylvania. Former decisions have established the right of a patentee to impose restrictions upon the future sale or use of a patented article, this being based on his ownership of a monopoly, and his consequent right to declare upon what terms he will admit the public to share in such ownership, or to profit by the use of the article. But if he sells the article without imposing any restriction upon its future sale or use, it passes at once out of the protection of the monopoly, and becomes irrevocably a part of the general property of the community, and may thereafter be bought and sold as freely as any article that has never been patented.

The question here arising was, whether this right in the owner of the patent to lay restrictions passes to his exclusive licensee for the sale of the article, so that the latter, without special authorization, may fix a price at which the property shall be sold to the ultimate purchaser at retail. Can this licensee, for example, prevent a department store from cutting the price on a watch? The court says no, he cannot.

Although the "licensees to sell" in the case at bar have extensive manufacturing works, these particular watches, if the statement of facts accepted by the court be true, were not made by them, but by the owners of the patent. These licensees are stated to have guaranteed the watches and called themselves the manufacturers and may be so considered in about the sense often given to that term by machinery people. The court, however, looks behind externals and concludes that legally they were not the manufacturers. This might have led to an interesting discussion of the topic, who is a manufacturer?

Before leaving this case it may aid our understanding if I state, and venture a curbstone opinion upon, a few questions bearing on the distinctions of law involved:

1. Is the general right of an owner of a patent to limit the price at which the patented article may be sold enforceable against anyone, no matter how far removed, into whose hands the article may come? Answer—I understand such to be the theory of the law. But something may depend upon whether the ultimate seller has notice of the restriction, as by a label on the article. (See 25 C. C. A., 267; 61 C. C. A. 58.)

2. Would a manufacturer who is using

the patent under license and royalty, and is making the goods, have the right to impose such a restriction? Answer—The point decided in this case does not show that he would not.

3. In a case like the present, could not the party licensed to sell, and without special authority to restrict, make an agreement with the immediate purchaser from him under which he could prevent that middleman from retailing the article at less than a stipulated price? Answer—On general principles, and in the absence of statutes to the contrary, I see no reason why such an agreement could not be enforced, so far at least as to give rise to damages if the thing were sold against the agreement. But this would have to be done as in an ordinary contract, not on the theory of a patent monopoly. Whether under any circumstances he might enforce a restriction against some subsequent purchaser who stood in no direct contractual relation to himself, we shall not here consider.

Fixing of selling price is not the only, nor perhaps the most usual, restriction by which maker of a machine may wish to keep a string in it after it leaves his possession, and the principles involved are quite general of application.

Be it remembered, in closing, that the case here commented on had not, when reported, yet reached the Circuit Court of Appeals.

147 Fed. Rep. 522.

THE ETHICS OF TRADE SECRETS

BY FREDERICK P. FISH

We have before referred to an address delivered before the A. S. M. E. by Mr. Fish, of Boston, who, besides being president of the American Telegraph and Telephone Company, is a lawyer of ability and wide experience, and a citizen interested in things which concern the public and the general welfare of society.

A question which had arisen in the administration of the affairs of the society, and in connection with which a paper that had been submitted by a member had been afterward withdrawn, prompted the late president of the society to invite and urge Mr. Fish to deliver an address upon the subject. This he kindly consented to do. Perhaps the paper might with more accuracy be called The Ethics and the Law of Trade Secrets. We, however, give it the title chosen by Mr. Fish, and we commend it to the careful attention of our readers. We give it nearly in full, as follows:

BEGINNING OF THE LAW

Letters patent for inventions, to be sure, grew out of the exception in the statute of James I (1623-4), which declared monopolies, so long a source of revenue to the British kings, and of hardship to the subject, to be illegal except when granted for a limited term for a new manufacture; but the development of patents and of patent law as an essential part of the prevailing industrial scheme did not really begin either in Great Britain or in this country until well into the nineteenth century.

In 1742 the great chancellor, Lord Hardwicke, declared that while every trader had his distinctive mark or stamp, he knew of no precedent for enjoining one trader from using another's mark, and he thought such a precedent would be mischievous. In 1803 such a precedent was established by Lord Eldon, in the case of Hogg vs. Kirby, 8 Ves. 215. From this time the law grew rapidly. Its progress has been especially marked during the past 30 years.

The definite development of the law of copyright, both that which is based on statute and that which is independent of legislative enactment, is in like manner comparatively modern. The first trade-secret case was decided less than 100 years ago.

In all the classes of rights to which I have referred there is this in common: Ideas or thoughts or plans or schemes, which are of value to the one who rightfully possesses them, are secured to him to a greater or lesser extent by the law. In the case of a trade mark, and of the cognate law preventing unfair competition, what is secured to the owner is a monopoly of the benefit which comes from the impression associated with the shape or appearance or brand of an article of manufacture which, lingering in the mind of the buyer, influences him in subsequent purchases to take what he believes to be goods of the same make as those which he bought before. There is a special analogy between trade secrets and letters patent for inventions on the one hand and common law and statutory copyright on the other. I shall again refer to this.

THE ANCIENT TRADE SECRETS

The trade secret, as we know it, as defined and determined by our rules of law which alone give it body and character, is therefore a comparatively modern institution. But there was a long history of trade secrets prior to our common-law recognition of them. It may be interesting to note briefly the great part that they have played in the industries, under conditions that have now passed away.

In all ages many trade secrets have been in the possession of individuals, but for a long period of time they also were a great asset of trading communities and frequently of guilds or associations. Every effort was made to preserve them for the few who had the benefit of them. Always and everywhere those who did not have the secrets sought to learn them. While not as a rule protected by systematic rules of law, kings and governments often intervened to aid their subjects to preserve the secrets they had, and to learn those which they did not know. All this was in accordance with the underlying laws of selfish human nature which prevail even to this day. It was a phase of the struggle for advancement that has characterized all progress. As in all other phases, the struggle was carried on by each generation according to the standards of the time, and those standards were sometimes not high. It seems clear, however, that the right to preserve a trade secret if one could, and to an equal degree the right to get the secret of another, by any means not offensive to the moral sense, were always recognized.

SECRETS OF THE SILK INDUSTRY

The history of the silk industry, up to a comparatively modern time, was largely confined to the disclosure of the secrets of the East to the people of the West, and later of one western community to another. The mysteries of cloth manufacture and dyeing were jealously guarded all through the Middle Ages. There are dramatic stories of the way in which such secrets were carried from one place to another. We read of James I of England smuggling three skilled workmen in hogsheads from France, to instruct his British subjects in the secret process of manufacturing the alum used in dyeing.

RESULT OF RELIGIOUS PERSECUTION

Many community trade secrets were disseminated by the religious persecution of the sixteenth and seventh centuries, which drove from the Netherlands and from France Protestant skilled workmen who were in the possession of those secrets. This had much to do with the development of industries in England, Germany and Switzerland. In particular, the revocation of the Edict of Nantes exiled from France thousands of Huguenot workmen, who were thus forced by the action of their own government to introduce into foreign countries secrets of French trade and manufacture, which otherwise might not have been discovered for years.

The modern art of hat making, prior to the revocation of the Edict of Nantes, had been entirely in the hands of certain of the French Protestants. They alone possessed the secret of the liquid composition which served to prepare properly the hare, rabbit and beaver skins used in hat making. So many of them were driven to England that the secret of their art was lost to France for more than 40 years, during which time the French nobility and all persons making pretense to elegance in dress wore none but English hats. Finally about the middle of the eighteenth century, a French hatter, named Mathieu, who was working in Lon-

don, stole the secret which the refugees had taken away and carried it back to France, where the industry was re-established. No greater blow was ever inflicted upon the industries and trade of a nation than in France by the revocation of the Edict of Nantes.

PORCELAIN

The great family of the Medici in the sixteenth century had a trade secret relating to the manufacture of a soft porcelain, which was subsequently lost, probably because it was too carefully guarded.

About the year 1710, John Frederic Bottger, who was in the employ of Frederic Augustus, Elector of Saxony, discovered the secret of making real porcelain. His master, the Elector, resolved that Bottger's discovery should remain a trade secret. He therefore kept Bottger in close confinement until his discovery was perfected to the point of finished work. He then established a factory within the fortress of Albrechtsburg. The drawbridge was always raised; none but the workmen could enter or leave the factory and they were bound by a solemn oath to keep until death the secret, if by accident they learned it. They knew that the severest punishment would follow any betrayal. This was the origin of the famous Dresden or Meissen ware. The secret of the Saxon Elector was, however, preserved only for a short time. About 1745, a runaway workman carried it to Vienna, where under royal patronage factories were established to practise it, which have turned out masterpieces of the potter's art. The secret was also carried to France about 1770, when the manufacture of the Sevres pottery began.

Long after the Flemish refugees, driven from the Netherlands by the religious persecutions of Philip II, had come to England, they kept to themselves as trade mysteries the manufacture of felt and the making of certain brass ware for culinary purposes.

GLASS MAKING IN ENGLAND

The establishment of the first glass factory in England was the result of the theft of a trade secret. An English admiral, angered by having been refused admittance to a French factory, hired away one of the workmen from that factory and founded an establishment at Ravenhead, Lancashire, which has continued almost, if not quite, to the present time.

The secrets of the production of Venetian glassware were guarded with most jealous care. No strangers could learn the art. Any workman carrying his skill to another country was followed and ordered back. If he refused to return, his relatives were imprisoned. If he still persisted, his life was in danger. It is recorded that a wandering Venetian glassmaker named Paoli was followed to Normandy, where he was stabbed with a dagger on which was written the word "Traitor."

TRADE SECRETS OF THE EAST

The East, as it always has been, is today a great field for trade secrets. We of the West do not know the mysteries of crackled china, of lace work, of translucent porcelain covered with glaze, or of the marvelous egg-shell cups and the process whereby they are enameled and covered with a finely woven case of bamboo. The same is true of many processes for the manipulation of metals and amalgams, which are known to the workmen of Japan, and by which are produced effects beyond the reach of the workmen of other countries.

The two oldest secret trade processes now in existence are said to be the manufacture of Chinese red or vermilion and the Damascus art of inlaying hardened steel with gold and silver.

Up to the capture of Damascus by Tamerlane the Damascus blade was the most famous weapon in the world. It could cut iron or gauze floating in the air. Tamerlane carried all the weapon makers of the captured city into a factory, where they continued their work. Their descendants are said to be skilled smiths in Samarcand to this day, but no more such blades are produced in Damascus. One can buy swords there today, but they are mostly "made in Germany."

Always and everywhere there has been a constant effort to discover the secrets of rival manufacturers or of rival communities. An interesting story on the subject is that of the Venetian, Braarti, who in the eighteenth century obtained a knowledge of the methods practised in the Bohemian glass works, by disguising himself as a porter and serving for three years in a glass factory in order that he might take home with him certain mysteries of the Bohemian art that were not known in his native city.

The day of the guild or trade association has long passed away. The time has also passed when, except in the East, a state or even an isolated community can hope to monopolize a trade secret which is shared by a substantial number of people. The ties which bind the workmen in any craft to their employer or to any comprehensive trade organization have long been, among the Western nations, too loose to prevent the dissemination of any trade device or method which is known to a large number of people. It can be no longer a secret if all those working in a trade in any locality are familiar with it.

A reference to these trade secrets of the olden time, which seem to have had for the most part no definite legal sanction, is only material as affording a basis upon which public sentiment, with the sanction of the law, has given to us our trade secrets of today. The whole industrial world was permeated with the idea of trade secrets and of their value. As the trades became more and more matters of individual enterprise, it was but natural that, with this history behind them, the sentiment of the community regarded them as a substantial thing to be dealt with on grounds of public policy. It has dealt with them, through the law, exactly as it has dealt with copyrights and trade marks, and I believe in a way that is quite in harmony with the general thought of the time.

OUR LAW OF TRADE SECRETS

When our law of trade secrets was first formulated less than a century ago, the industrial conditions were nearly as remote from those of the present day as they were from those of the Middle Ages. The trades had, however, come generally into the hands of individuals. We had started on a line of industrial organization and development which has been consistently followed to the present time. Almost the cardinal principle of this line of development has been the encouragement of the individual to risk and effort. It has been generally recognized that the gain to the community would be the greatest if every member of it was stimulated to do his utmost for himself. There is need for encouragement to individual thought and effort. No one is likely to face the trouble, anxiety and cost of experimenting and testing new ideas which are sure to fail in the majority of cases, with the chance of great loss, unless he can look forward to a reward if he succeeds.

ENCOURAGEMENT TO EXPERIMENT

This thought was not new with the last century. It has always existed. Men have always been encouraged to seek individual prosperity as probably the best way to promote the common good. It may well be that the whole doctrine of the right to property, which seems to us instinctive, rests upon this foundation. But with the expanding manufactures, trade, and commerce of the last hundred years, the idea has become dominant as never before and has been definitely reflected in our institutions and laws. Certainly there can be, as a practical matter, no greater stimulus to the individual to do the best there is in him, toward building up the industry with which he is concerned, than the certainty that he may secure and maintain for his own use that which he has acquired fairly and honestly according to the standards of his time. If such is the case, the greatest good of the greatest number must require that there should be a gain to him for his contribution to the well being of the community by way of original thought and initiative, as well as by way of good business methods or administrative capacity or ardent labor.

INTEREST OF THE INDIVIDUAL AND OF THE PUBLIC

There has never been a time when there were not some dissenters from this general view. Those who have been unsuccessful have sometimes failed to admit its

validity. Many have speculated as to whether there were not conceivable industrial conditions, other and perhaps better than those which prevailed, in which so much encouragement would not be given to the individual, but in which the requisite effort could be secured on other and less selfish grounds. And there have been times in which the natural and perhaps inevitable development of current industrial methods has been such as to bring about a revulsion of public sentiment, more or less sound, and more or less justifiable, but at any rate to be taken into consideration as definitely affecting the trend of development of industrial ideas and industrial conditions. But it does not seem possible to deny that the general sentiment has almost always been in favor of the encouragement of the individual in his selfish aspirations for personal prosperity.

I see nothing in the temper of our own times to indicate that this broad view of what is for the common good has been shaken. Few doubt that an individual should get a personal benefit from his personal skill and energy. We believe that the better and more useful the workman, the more he should have the rewards of life. The public generally agrees that the more one contributes to the progress of the arts as an inventor, the more he should have for his personal use, and that the reward of the tradesman or manufacturer should be based, to a substantial extent, upon the skill, energy, capacity and honesty with which he carries on and builds up his business. We know that the entire community profits by the deserved success of any individual in it. We feel instinctively that, if the efforts of individuals are attacked or discouraged, all will suffer. The time may come when different views will prevail, but I do not anticipate that such will be the fact.

It has of course always been understood that the gain to the individual should be acquired honestly in accordance with the prevailing standards of the time. Sometimes the community has decided that the prevailing standards were wrong—that is to say, inconsistent with the general welfare. Then the standards have been more or less changed and new ones established, occasionally after marked political and business convulsions; but when the convulsions were over and a readjustment to new conditions attained, it has been found that the right of a man to a fitting reward for his contribution to the public well being was respected as much as ever, and that society instinctively proceeded upon the old principle that individuals must be encouraged to prosper as the only known means of securing to the community the gain in productive power and the progress in industrial effort that was essential.

It is upon these fundamental principles that the underlying right to the protection of a trade secret, in so far as it is or can be protected, depends. The right is logical and will be asserted and enforced by public sentiment and by the law, which, as I have already said, is in the long run a reflection of public sentiment, until we cease to believe that individual effort should be encouraged as the most effective stimulus to industrial improvement. When, if ever, doctrines like those of socialism prevail, many rights which seem to us natural and proper, may disappear, among them, perhaps, the right to protection against the disclosures of a trade secret to the extent to which that right now exists.

TRADE SECRET DEFINED

A trade secret is some method of manipulating or combining materials, or of controlling or directing the forces of nature, or of organizing machinery, or the details of a business, which is the result of original thought, which is of trade value to the person who has the thought, or the right to apply it, and which is kept by him a secret that he may get from it a personal advantage not to be directly shared by his competitors. Let us take the simplest possible case. A manufacturer of dye stuffs, through his own ingenuity or thoughtfulness, or through the ingenuity or thoughtfulness of others whom he has employed, finds out that his product can be increased or improved, or that he can get a new product, by a certain process that is not at the time employed in the art. It is clear that under none of our standards, either of law or of ethics, is the manufacturer under an obligation to use this process or to disclose it to anyone. I doubt if there can ever be any effective law supporting such an obligation, and in the absence of such a law any sentiment of the community, even if it existed, would be inoperative. But neither the law nor the sentiment exists today.

The secret, therefore, is the man's own, to keep or to disclose, to use or not to use, as he pleases. No public policy or law can force its disclosure or use. But the one who has it can be encouraged to disclose it or use it, one or both. The patent law offers a reward for the disclosure of secrets of a certain sort, and incidentally encourages their use. I shall have a word to say later as to the bearing of letters patent on the subject under discussion. The law relating to trade secrets does not tend to promote the disclosure of them, but the contrary. It does encourage their use.

ENCOURAGEMENT TO USE SECRETS

If such a secret is of the slightest value, its use as distinguished from its suppression is obviously desirable. If it is suppressed, no one gets any advantage from it. Who is benefited if it is put into use? Is not the answer to this question clear? The possessor of the secret will get some benefit from its use; but the community as a whole is far better off if the secret is utilized. By practising the secret, the possessor of it will be getting, by a given expenditure of capital and of effort, a new product or a cheaper or a better product. He will get a profit for himself, but not all of the profit; some of it will inevitably go to the public. He will be adding to his own wealth, but he will also be adding to the wealth of the state, of which his own wealth forms a part. His business will prosper; he will employ more workmen; the efficiency of his industry will be enlarged; it will be of more general advantage to the community; the well being of society will thereby be advanced. All this follows whenever there is an improvement in an art which is actually utilized. No argument seems to be required to show that society is better off, if the new thing is employed in practise, than would be the case if it were not used at all.

The possessor of a trade secret, who need not use or disclose it, and who is unwilling to publish it, should therefore surely be encouraged to use it. The law, recognizing this fact, affords him the only form of encouragement that is really possible, namely, a certain limited aid in his effort to practise and utilize his secret without losing it. It helps him keep his secret.

LEGAL PROTECTION FOR TRADE SECRETS

It has never been suggested that the law should go so far as to protect a trade secret that was not a real secret. Such a proposition is entirely inconsistent with the common sense and intelligence of mankind. However brilliant may be a thought or an idea, whether it is of value to the industries or to literature or art, when without dishonesty, fraud or treachery it has once become known, it is common property. There are men so high minded that they would disdain to use the ideas of others, even if they had the right so to do; but such a view is not universal, and it would be utterly impracticable to seek generally to preserve for one, even if he has originated it, a thought or an idea that has without wrong become disclosed to others, so that it is no longer a secret. But the law *can* say, to encourage the use of such a secret, that those who are bound by contract or by good faith to aid in keeping it shall be held to their obligation.

It is just to this extent and no further that trade secrets are protected. The law does not intervene to protect the secret against discovery by fair and honest means. It does not undertake to make the secret, as such, secure. It only enables it to be utilized, for the good of the possessor and of the public, without danger of betrayal by those who must necessarily learn the secret in confidence while it is being operated as a secret, and who can betray it only by what the law regards as a breach of honesty and fair dealing.

BETRAYAL BY EMPLOYEES

The man who is practising his trade secret must have associates and workmen. Some of them will inevitably learn

the secret. Is it not fair and reasonable that, learning the secret under such conditions, they should be forced to respect it? It is by their voluntary act that they enter into such relations. Having established them, should they not be bound by the necessary implication that it was part of the understanding that they should keep what they know to be the valuable secret of the man with whom they are associated? There would seem to be no question in the case of an express contract. Should not a confidential relation, clearly involving an implicated contract, be equally effective?

There may be others, not directly associated with the work, to whom the secret is imparted in confidence. Is it not proper that they should regard that confidence? Does it not appeal to us as right that those who receive a secret of this sort, because of a confidential relation which involves a knowledge of the secret, should respect it, and be bound not to disclose it?

If the law and public sentiment were otherwise, no trade secret could ever be safely put into use. By holding to what seems to be only a fair standard of business ethics, those who gain a knowledge of the secret through a contract or a confidence that is reposed upon them are prevented from disclosing it, and the desired result is accomplished. The possessor of the secret is not, to the detriment of the community, tempted to refrain from using it; but he is encouraged to practise it for the gain there is in it, knowing that so far as he used it as a secret, those who are in the secret are bound to co-operate with him in protecting it against disclosure.

BETRAYAL BY BREACH OF CONFIDENCE

It has been settled by an almost unbroken line of authorities, and it is absolutely clear at the present stage of the law, that a trade secret will be protected against disclosure by anyone who has received it in confidence and under such circumstances that there is a contract, express or implied, that the person to whom the secret was disclosed should himself respect it. It follows that there is also a remedy against those who have received a disclosure of the secret from persons guilty of a breach of confidence or of contract in imparting it, unless they themselves were both entirely honest in the matter and protected by the equities of the situation. Against all others the owner has no redress. He can only invoke the power of the law to make effective an obligation to respect his confidence and to live up to an agreement.

The question has most frequently arisen, and is most likely to arise in connection with the employees of one who is actually practising a secret. These men must, from the nature of their employment, know the secret or be in a position to discover it. In dealing with a case of this sort, an English chancellor, in the case of Morison vs. Moat, 9 Hare 241 (21 L. J. Ch. 248), laid down the law in the following words:

"The principles that were argued in this case are principles really not to be called in controversy. There is no doubt whatever that where a party who has a secret in a trade employs persons under contract, express or implied, or under duty, express or implied, those persons cannot gain the knowledge of that secret and then set it up against their employer."

In Stone et al. vs. Goss et al., 65 N. J. Eq., 756, the court says:

"These cases establish the principle that employees of one having a trade secret, who are under an express contract, or a contract implied from their confidential relation to their employer, not to disclose that secret, will be enjoined from divulging the same to the injury of their employer, whether before or after they have left his employ; and that other persons, who induce the employee to disclose the secret, knowing of his contract not to disclose the same, or knowing that his disclosure is in violation of the confidence reposed in him by his employer, will be enjoined from making any use of the information so obtained, although they might have reached the same result independently by their own experiments or efforts. We approve the principle thus established."

Again, in Westervelt et al. vs. National Paper, etc., Co., 154 Ind. 673, the court says:

"It was the understanding and agreement between appellee and said Taggart that his ideas and inventions and discoveries concerning said proposed machine should belong to appellee, and it was not contemplated by either party that a patent should be taken out upon anything which he might invent or discover, but that it should be kept a secret. It was a part of the said contract with said Taggart that he should make a complete machine for appellee, and for no other person, and both parties understood by that language that no machine embodying the ideas which said Taggart expected to put into practical form should be made by him for any other person, and his perfected ideas should not be divulged to any other person."

Taggart entered the employment of appellee and designed a machine, which appellee completed. Then Taggart entered into a contract with the other appellant for three years to make his machine, and employed the same draftsman as appellee to furnish drawings.

"It is evident from the authorities cited that if a person employs another to work for him in a business in which he makes use of a secret process, or of machinery invented by himself, or by others for him, but the nature and particulars of which he desires to keep a secret, and of which desire on the part of the employer the employee has notice at the time of his employment, even if there is no express contract on the part of the employee not to divulge said secret process or machinery the law will imply a promise to keep the employer's secret thus entrusted to him; and any attempt on his part to use the secret process, or machinery, or to construct the machinery for his own use as against the master, or to communicate said secret to others, or in any manner to aid others in using the same, or in constructing the machinery, will not only be a breach of his contract with his employer but a breach of confidence and violation of duty which will be enjoined by a court of equity. . . .

"Under the facts alleged, even if no agreement was made, one would be implied, that he was not to disclose the secret of the construction of the machine, or impart any information by which anyone could construct such a machine. He occupied a confidential relation to the appellee and in such case the law raises an implied contract between them that the employee will not disclose any trade secret imparted to him, or discovered by him, in the course of his employment. A disclosure of such secrets thus acquired is not only a breach of contract on his part, but is a breach of trust which a court of equity will prevent."

Perhaps the leading case on the subject in this country is that of Peabody et al. vs. Norfolk et al., 98 Mass. 452, in which Judge Gray, speaking for the Supreme Court of Massachusetts, stated the law as follows:

"It is the policy of the law, for the advantage of the public, to encourage and protect invention and commercial enterprise. If a man establishes a business and makes it valuable by his skill and attention, the good will of that business is recognized by the law as property. If he adopts and publicly uses a trade-mark, he has a remedy, either at law or in equity, against those who undertake to use it without his permission. If he makes a new and useful invention of any machine or composition of matter, he may, upon filing in a public office a description of it which will enable an expert to understand and manufacture it, and thus affording to all persons the means of ultimately availing themselves of it, obtain Letters Patent from the government securing to him exclusive use and profit for a term of years. If he invents or discovers, and keeps secret, a process of manufacture, whether a proper subject for a patent or not, he has not indeed an exclusive right to it as against the public, or against those who in good faith acquire knowledge of it; but he has a property in it, which a court of chancery will protect against one who in violation of contract and breach of confidence undertakes to apply it to his own use or to disclose it to third persons. The jurisdiction in equity to interfere by injunction to prevent such a breach of trust, when the injury would be

irreparable and the remedy at law inadequate, is well established by authority."

The court then cites a number of the leading cases and concludes by sustaining the right of the court to interfere to protect the disclosure of a trade secret where there is a "violation of contract and breach of confidence."

This doctrine is supported by practically an unbroken line of authorities. It is like the doctrines of the common law which protect trade marks, and which prohibit the pirating of unpublished dramatic performances, the publication of letters without the consent of the sender, and many other violations of fundamental and personal rights. It is based upon the conception by the courts of what is for the public interest and what is fair, proper and honest, as between man and man. There always has to be a legal ground for the application by the courts of a principle of sound morals, and in this connection there is some question in the cases as to whether a trade secret is to be protected as property or because there is a contract, express or implied, or because the disclosure would be a breach of trust. It does not seem profitable at this time to enter upon a discussion of these refinements. For all practical purposes, the views of the courts are based upon a single and simple proposition. An individual is justly and honestly in possession of what is a real trade secret, that is, something useful in his business that is known to him and protected by him to the extent of his power as a secret of his trade. There seems no doubt that this is a real property interest exactly as an invention is property to such an extent that the government can make a contract with reference to it by which it is protected for a limited term by a patent, and exactly as an artistic or literary expression is protected as property. But in any event, it is obviously unfair that those who have entered into a fiduciary relationship with the possessor of the secret, or who by express contract or by a consideration of the relationship must necessarily be said to have assented to an implied contract to protect the secret, should undertake to rob the owner of his secret by communicating it to others or using it themselves. The necessity of resenting and checking such unfairness must appeal to all of us as it invariably appealed to the courts. In a large number of the cases that have been before the courts, there has been no express agreement to protect the trade secret. There has been held to be, however, a necessary implication that such an agreement existed because of the relation of service. As the court said in Robb v. Green (1895) 2 Q. B. 315:

"Where the Court sees that there is a matter of this kind which both parties must necessarily have had in their minds when entering into a contract, that is precisely the case in which it ought to imply a stipulation."

In Merryweather v. Moore (1892) 2 Ch. 518 (Ch. Div:), the English court said:

"It is sometimes difficult to say whether the Court has proceeded on the implied contract or the confidence, for I will put aside once for all any cases arising on express contract. Perhaps the real solution is that the confidence postulates an implied contract; that, when the Court is satisfied of the existence of the confidential relation, then it at once infers or implies the contract arising from that confidential relation—a contract which thus calls into exercise the jurisdiction to which I have referred."

(To be concluded next week.)

"The Art of Cutting Metals"

BY ENTROPY

When your readers see the size of the volume containing F. W. Taylor's address on "The Art of Cutting Metals" it is to be feared that they will be so impressed with the greatness of the task of reading it that they will pass it by. This is not to be wondered at, for in the present time of sunshine your readers are so busy making hay that they are likely to be neither blest with the patience nor cursed with the time to read it.

THE SALIENT FEATURE

This may make an excuse for me to say in a small space what has impressed me as the salient feature of the work, from a shop man's point of view. Under the Taylor system, thinking in the shop by workmen is not allowed; yet he gives here plenty of food for thought for all parties to a manufacturing plant—and, after all, he advances hardly any new ideas. Almost all his general conclusions are well known to men in the shops, whether they are known to their employers or not. Workmen have used for years a form of tool which so nearly approximates Mr. Taylor's that it would be hard to tell which is best. It is called in these parts a half-diamond point, and we grind it almost exactly as he tells us to do, as I find by actually measuring one at random. We know that a coarse feed and corresponding slow speed will rough out work most quickly, and that a dripping of water on the tool does no good; but those who work on turret-lathe work do just what he does and flood with cheap oil, soap and water, or soda water. We know that a very dull tool will smash up a lathe apron if it is gear fed, for we have all tried it. We have used Mushet tools (that we have had tucked away in odd corners) for turning steel, and even for finishing cuts, at a time when all tool-steel salesmen claimed they were good for nothing but cast iron. Every once in a while we got hold of a Mushet tool which the blacksmith had burned, and we found it would hold an edge indefinitely. I remember one chum of mine who got hold of a bit of Mushet this way, and who used it to turn lathe spindles with for at least three years, running it fully one-third the time without having it dressed. Not every piece of Mushet would act this way, as I know to my sorrow, but this particular one seemed to have a charmed life. These are Mr. Taylor's principal conclusions, and to him is due all credit for getting them together in logical form, so that his results are of use to a man who does not know these things by that unnamed sense which everyone has developed more or less who has labored as a machinist.

THE REAL POINT OF INTEREST

It is not in these conclusions that our interest lies, but in the relative gain from each of the separate elements. For instance, if we begin with the worst conditions which appear to be possible when using carbon steel, and change to high-speed steel, we shall be able to run seven times as fast. If we consider our first tool to have been a V-thread tool and the second a broad round nose, we may be able to run six times as fast again, or a total of 42 times. If we use a feed of 3/16 inch with the carbon steel and 1/64 inch with the other, we may be able to speed up 3½ times again, or a total of 147 times. If we run on a copious stream of water, we should speed up 1.4 times again, or a total of 205.8 times. If we were running with a depth of cut of ½ inch and reduced it to ⅛ inch with the high-speed steel, we might gain 1.36 times, or a total of 281 times. If finally we change from the worst possible material to the best to cut, we may speed up 100 times, or a total of 28,100 times.

Of course this is impossible, but it will illustrate what I wish to show. The extreme range of possible speeding up which Mr. Taylor shows comes from his having tried only one thing at a time. Reading his paper would apparently justify one in piling these gains one on top of the other, as I have done here; but experiments in which one of these items was tried in connection with another would show that they had an influence on each other. Then again, nobody has yet succeeded in getting all the worst conditions together, any more than they have succeeded in getting all the best. Still it seems to me that for the following comparisons these figures may be safely used:

THE EMPLOYER'S AND THE WORKMAN'S SHARE

Out of all the things above mentioned all that are ordinarily left to the individual workman are these: feed, which may make a difference of 1 to 3½ in the speed of cut; shape of cutting edge, which may make a difference of 1 to 6; depth of cut, which may make a difference of 1 to 1.36, or a total of 1 to 28.56. That is, a man in the shop left to his own devices but running a tool to destruction in the standard time may run it 28 times as fast by observing Mr. Taylor's rules as by doing

the worst he can do. This leaves it possible for the management to speed up the other thousand times out of the 28,000 total. Early in Mr. Taylor's address he modestly speaks of increasing the output of a shop to double its old capacity by observing his rules. If we are to be content to increase our shop output only to this extent, keeping the same relation between various factors as above, then it becomes evident that the workman's share in the speeding-up process becomes almost negligible.

INFLUENCE OF THE MATERIAL

Now the conclusion which I draw from this is that before a manufacturer tries to make his machinists mere automatons, he should use more care on his part to see that his share of the opportunities to speed up are not lost. The most of this possibility lies, according to Mr. Taylor (and I believe him to be right), in the material used. It is surely the least considered of all, in every shop that I have had a chance to learn about. Hard castings have always been thrown out. But how many shops have any fixed degree of hardness at which they say that they will throw away a casting, short of sheer inability to cut the material at all? How many shops, or foundries either, can tell whether the castings from the last heat are harder or softer than the one before? How many shops, outside the textile machinery shops, ever anneal a casting? Who knows just how much gain in speed is possible by annealing? We know it is big, big enough to pay, but just how big we do not know.

LOSS OF STRENGTH BY ANNEALING

We are sometimes afraid of annealing for fear of loss of strength. Some tests I had made recently showed a drop of 10 per cent. in transverse strength from annealing square bars. Some other tests showed an equal variation through change of mixture, which the customer knew nothing about. I can imagine sections which might be strengthened by annealing. We hear rumors that some shops are using soft steel for parts requiring a hard surface, case-hardening it after roughing out, and finishing by grinding. If there is some safe way to know just what is going to happen when we case-harden, this rumor ought to be spread more freely. There are no data, or almost none, as to the mixture of iron that will finish to look clean and bright with the least power. Here is a field all unworked, and the broadest one of all—one that does not involve relegating workmen to endless drudgery, leaving them with nothing on their minds but to think of the tyranny that keeps them from thinking about their work.

GETTING THE WORK READY

Then there is the item of getting work on the machine. Not all of us can center up a chuck and swing it in a lathe, and just watch the cut for a day or two. The best man I ever saw on a planer knew next to nothing about using a coarse feed, but he could strap a piece on the planer and get it going while the rest of us were hunting up blocking. In a shop where they have holders for everything he would have been at a discount, but in a simon-pure machine shop he had us all beat and a shop may not be behind the times just because they don't jig everything. It may be they never have two jobs alike. In such a shop men who can think and are allowed to think must do the work, and they will throw up their jobs if their feeds and speeds are set for them, just as quickly as your doctor would if you should diagnose your own case and ask him to deal out the medicine.

The Question of Skilled Labor

We are at present, perhaps, near the crest of a period of unequaled industrial activity and widespread prosperity. The manufacturer finds himself daily confronted with the difficulty in getting suitable workmen for any but the roughest tasks. Of course, the old skilled craftsman is almost a creature of another age, so far as the large needs of industry are concerned. The difficulty has at present taken on a yet more serious turn in that it is most troublesome to get even the partially practised workmen necessary under modern conditions. Twentieth-century American methods carry with them this internal danger that by restricting the scope of a workman's activity to one or a few operations, the general grade of labor will deteriorate to a very serious degree. The cry of manual labor as against machine work is a very old one and its general foolishness has been pretty well demonstrated by years of increasing prosperity among laboring men. The present feeling of unrest, which it is quite useless to deny, has, however, a very different basis, which is worthy of much graver consideration. The question which the laboring man now asks is not whether his handiwork is to be replaced, but whether the fragment of a trade which is left him under modern specialization is sufficient to insure him a livelihood under average conditions. And the employer asks, not whether he can get well trained craftsmen, but whether he can meet the sudden fluctuations of supply and demand in face of that complete lack of versatility which the modern methods have enforced.

The situation is a somewhat perilous one, that deserves the sober thought of all men. How far can specialized labor be still further specialized without making the laborer dependent for his daily bread not on his trade, let us say, as a brickmaker, but on the continuity of operation desirable under trade conditions in yard No. 67 of the Cosmic Building Materials Company?

If industry is to progress some provision must be made for answering this question. It cannot be settled by any method of industrial education or by any mandate of a trades union. It cannot be put aside as part of the old anti-machinery crusade, for it strikes far deeper. When hard times come the man with the hoe is a plutocrat compared with the man who runs the semi-automatic crimper of the Corrugated Leather Washboard Company. The former can still hoe beans, but the latter sits on his doorstep and wonders when the executive committee will let the works start up. He has run his machine month in and month out, nine hours a day, with never a change save to quicken his pace when the price of piecework was from time to time cut, and this is the end of his opportunity, and all he knows how to do. The world moves and the day of old-fashioned trades has gone by, perhaps forever, but the new situation faces us with menace, and it remains not to find out a line of retreat, but a practical line of advance. There have been from time to time various experiments in the encouragement of individual effort, in profit-sharing and in various sorts of co-operation. They are extremely interesting, even though they only scratch the surface of the subject. They show that men are thinking and working along various lines toward improvement. But it is none too soon, and no activity is too great. The industrial situation cannot adjust itself by the establishment of an apprentice system and a few trade schools, nor by grub-staking baseball teams among the employees. The problem is how to prevent, say, five million workers, who have each only a disorganized fragment of a calling, from joining the great army of the unemployable when hard times forces them out of their present jobs. The mass of workers imperiled under the abolition of trades is so huge that the problem of dealing with it must be taken very seriously. When the possibilities of the case involve the first principles of self-preservation, as they do in the present instance, it is time for statesmen to take thought.—*Engineering Record.*

In his annual report to Congress Postmaster General Cortelyou advocates the general advance in salaries to which we have previously referred, says that competent employees are constantly leaving the service to obtain better wages elsewhere and that the increased cost of living justifies the increase of salaries proposed. He also says that it may seem advisable to use automatic stamp-vending machines, which he says have been experimented with already. In this connection it may be recalled that for some years the elevated railroad in Berlin has employed automatic ticket vending machines, and as the price of a certain ticket is not even with any German coin, the machine is arranged so that when the proper coin is inserted it delivers the ticket, and a pfennig change.

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Broaching an Internal Gear—A Difficult Piece of Work Machined Satisfactorily with a Sectional Broach

We had a large order on hand for internal gears like Fig. 1, and the only available tools were a 24-inch Hendey shaper and a Watson & Stillman broaching press.

SECTIONAL TOOL DECIDED UPON

The shaper would do a good job, but was very slow, so we decided to make a broach, like Fig. 2, which I must say worked beautifully. We had some trouble, of course, in starting the job, and had the expense not been so great we should have made two broaches with a smaller cut for each tooth, which would of course have taken a little more time. However, as the job did not require the greatest accuracy, and this being a case of quantity in the least amount of time, it was decided to make one broach answer.

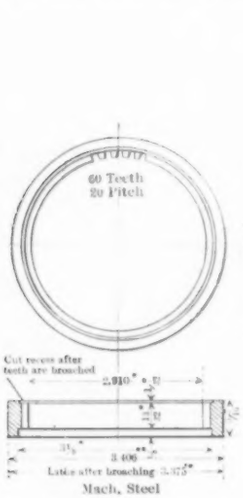


FIG. 1

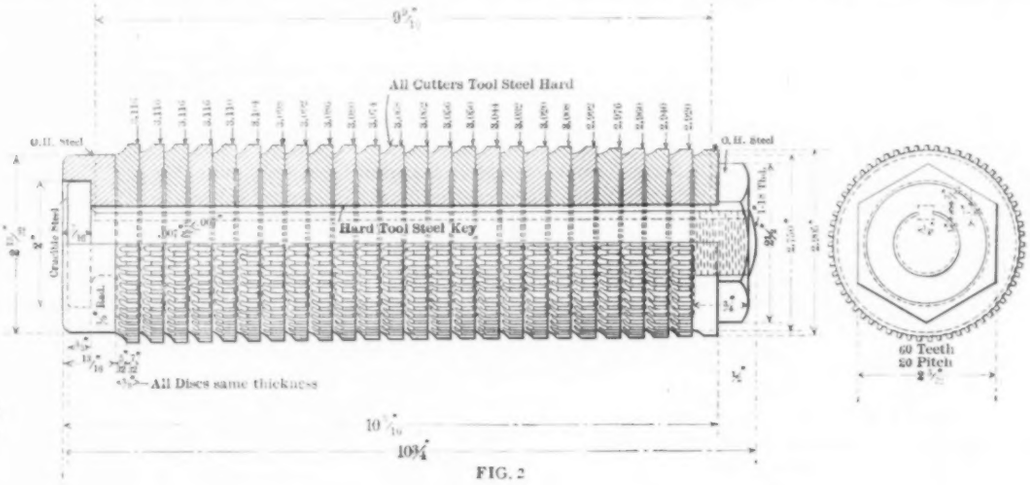


FIG. 2

THE WORK AND THE BROACH

CONSTRUCTION OF BROACH

The broach was made of tool-steel disks, turned to sizes given in sketch in Fig. 1, with a crucible-steel binding bolt not hardened, as we were afraid it would warp; this was a very important point as we depended on the key, which was hardened and ground, to bring the teeth in line. The disks were turned in the usual manner, allowance being made for grinding on the face. The key-way was then put in to gage. The teeth were cut on a mandrel with a taper shank to fit the dividing head, and a key to fit the cutter, so the teeth could be located uniformly from the key.

MAKING THE CUT AND FINISHING THE BROACH

The cut was made about one-half degree taper, and small in the back for clearance. It was necessary only to set the cutter once for the entire lot of broaches, as the bottom of the teeth remained the same. After the broaches were hardened (which was done with care), we ground the faces, then clamped them against the face, getting them as true as possible by using the comparator on the outside diameter. The teeth were not perfectly in line after assembling, but were commercially "good enough."

TROUBLES AND HOW THEY WERE OVERCOME

The first trouble was in the tearing of the teeth on the bottom side, as the rings were drop forgings, and very tough; but by leaving the small counterbore until after the broaching operation, and using the best grade of lard oil, we were able to keep that part of the trouble down to a minimum. The next trouble experienced was in the broach running to one side, bringing the teeth out of truth with the outside, on which we found it necessary to leave a light cut to be taken off after the teeth were cut, and this was the end of the trouble. When you consider that we broached from 200 to 225 of these gears in ten hours, you will understand we were well paid for the trouble, and we hope some of the AMERICAN MACHINIST readers may be benefited by our experience.

L. E. S.

Saving Labor in Business Correspondence

In Mr. Osborne's article, at page 696, Vol. 29, Part 2, he outlines a fine scheme for saving labor in answering "hurry-up" letters, but gives credit for the idea to the system of marking drawings used by the International Correspondence Schools. I hope I shall not be considered irreverent if I suggest as a much older origin for the scheme the incident of the small boy who got tired of saying his prayers every night, so (seeing here only the objective and being quite ignorant of the subjective element) he neatly lettered the prayers and hung the placard up on the wall; and when bedtime arrived he knelt down, pointed to the placard and said: "Good Lord, them's my sentiments."

Mr. Osborne has foreseen the danger of wrong combinations being made; now why doesn't he design, for stamping the numbers on a card, a machine with an elaborate interlocking system to avoid this disaster? It merely takes some ingenuity, which I have no doubt Mr. Osborne can supply if he is assured of a market for the machine.

In this connection, it may be useful to call attention to a labor-saving wrinkle which is actually in use. There is a vast amount of correspondence between the

different departments of a railroad, the red tape being often almost governmental in rigor. I knew of an important official who had a great number of matters to follow up, involving correspondence with pretty nearly all of the other departments, besides hundreds of outside parties; and the scheme his office followed in sending out "punchers" depended upon a similar principle to that of the one referred to above, though it would be better suited for Mr. Osborne's own use rather than that of the concerns who furnish his raw material; it may in fact serve Mr. Osborne for ammunition for defense when specimens of his own invention begin to strike him. A regular printed form was used, and in sending it out it was necessary merely to fill in the name of the party addressed, the date of the original letter sent him, the subject to which it pertained, and the serial number of the "puncher." When an office began to get "punchers" with comparatively high numbers it thought that it was about time there was something doing about the matter in question; for those high numbers don't look well on the records.

BRACHISTOCHRONE.

Punch and Die Designing

It is very interesting to a diemaker who travels from one shop to another, to note the different methods employed in different shops for the production of practically the same piece of work. All the difference is caused by the style of press to be used for the production of parts. One press used is inclined while the other is vertical, and for that reason a different design of die must be used for each. These are shown in Figs. 1 and 2.

A large quantity of these laminated pole pieces, 0.014 inch thick, are used daily. The outsides are exactly alike, the only difference being in the location and size of the holes. If the dies were made in one piece a small flaw would spoil the entire die; on the other hand, if the dies were made in sections all the cutting edges and sides could be ground to fit the model, and in case something should break during operation it could easily be replaced with very little expense or trouble. To accurately locate the holes in the punches and section parts for the piercing bushings *N* and *G* is very essential, as they have to fit the model with four plugs in the holes, and each one must line up so that the plugs will not stick when they are all in. That was done in the following manner. The pieces were machined perfectly square all over, allowing stock for finish to shape after all the holes are bored and reamed. The location of one hole was approximately laid out, and one hole bored and reamed in a lathe, by strapping the piece to the face-plate. Before loosening the straps by which the work was held, two parallels were strapped to the face-plate bearing against two sides of the work. The straps holding the work were then loosened and the work removed and cleaned of all dirt, chips, and oil, then placed on the face-plate again with a size block between the parallels and the work. These size blocks had previously been made to sizes required. The work was then fastened with straps and another hole bored and reamed. By repeating this operation and adding a size block each time until all of the holes were bored it was possible to space the work far more accurately than would have been possible by time-honored method of laying it out with dividers.

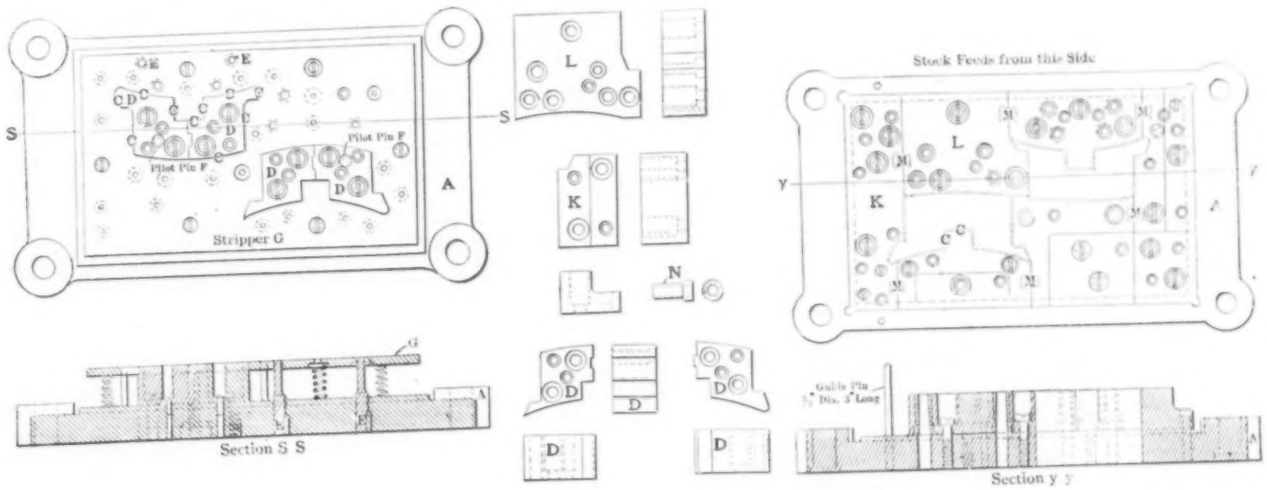


FIG. 1. THE PUNCH AND DIE FOR THE FIRST METHOD

At Fig. 1 is shown a punch and die for an upright press, designed so that the punchings drop through the die. Its construction is very simple and readily understood. The punch and die are made in tandem fashion so as to save as much as possible of the material, and at the same time increase the output to its maximum. The section pieces are fastened on a cast-iron holder *A*, and the two holders slide on four sub-press pins *B*, so that the punch and die have no possible chance to get out of line. The minimum allowance between sub-pin bosses is one inch when the punch and die are entered. As the punch and die are ground the bosses will be relieved by counter-boring. The punch sections *D*, after the holes are bored and reamed, are laid out from the model by having plugs which fit the holes in the punch and model. A line is drawn on the outside around the model, and the section is then machined to the line, then hand-worked down with a file and scraper until the surface square bears on the model and punches, around on all the sides, allowing 0.002 or 0.003 for grinding, which is done by having a piece of sheet brass the right thickness between the model and the surface of the square. I have experienced great trouble in keeping the lines visible on the work, for no matter how deep you scratch them, when you come down within 0.005 of the lines they are lost. If the piece of work is heated to a blue color, and when cold a line is scratched on it, the line can be seen until it is cut in half. This beats anything yet tried.

The punch sections are fastened with two screws and two dowels. The dowel-pin holes in all hardened sections are relieved so that the pin will have ⅜-inch of bearing. The punches are hardened and ground all over to fit the model, and the cutting edges on all tool-steel parts are hardened so that a file cannot scratch them. In front of the punches are piercing plugs *E* a drive fit and held in the cast-iron holder by a straight pin on one side. On top of each punch is driven a pilot pin *F*, to locate the metal in the right position. Outside the punches is a ⅜-inch stripper plate *G*, made of machinery steel, which is held up by 22 spiral springs and adjusted to the hight of the punches by 6 flat head 5/16-inch screws.

Small holes will be noticed in the center of the spring seats. That is done in the following way: All the holes in the stripper are laid out in the usual way and drilled through with a 3/32-inch drill, then the stripper is placed on the punch plate with the punches in, and all the holes spotted in the cast-iron holder. In this way all the holes are in alinement. The detail sections *K L*, etc., of the die, are also fastened to the cast-iron holder with two or three screws and two dowel-pins. The cutting edge is hardened and tapered one degree from the bottom, and ground to fit the model. All parts, when possible, are relieved, as shown in *K*, so as to reduce grinding on the face. When the die is assembled each section is wedged together, as shown at *M*. In this way the die is as secure as if solid. In front of the die holes are four bushing holes counterbored from the bottom. These holes are plugged after the die is assembled and drilled, and reamed from the punch. When placed together afterward they are tapered one degree from the bottom with a reamer. A pin holds the piercing bushing *N* in the right position. After hardening the die is used in a C-5 Ferracute press.

The punch in Fig. 2 is designed similar to the other, except the four follow-punch bushings are located in the punch itself, and the punch sections *D* are held to the cast-iron holder with four screws and two dowels. The four follow-punch holes *L* are drilled and counterbored to measurements before they are hardened. A 3/8-inch stripper plate *F* is placed on the outside of the punches and held up by 24 spiral springs, and adjusted to the hight by six flat-head screws, with a nut from the bottom. After the punches are hardened and ground the follow-punch bushings *G* are driven in, but they are first located in the die from the model, then transferred from the die on to the punch. The die is also constructed a little differently from the other in having the piercing punches inside the die as well as the stripper, and held from the outside with set screws to keep them from changing. Only a few of the sections are shown in detail, as they will be readily understood from the details *I* and *J*. They are all held with two or six screws and two dowel-pins, and they are all relieved to save grinding as much as possible. After being hardened the cutting edges are ground square to fit the model, and the sides are ground to match into one another. It will be noticed that piece *K* is held with one screw and two dowel-pins. This is done because in one lot they wanted this in while in another lot they wanted it out. When this is the case we then merely take the piece *K* from the die and place it in the punch section; in this way we have the punch solid, and the punchings will have no cut in the middle. In this operation we have the punch on the bed of the press and the die on top, and two guide pins *M* are placed on each side, and on the end of the punch, so located that they are 3/32 inch from the cutting edge. No pilots are used on this die, but the ordinary cam lever feed. The punch and die are used in an inclined press, which causes the punchings to fall by gravity after being punched.

R. A. ALMOND.

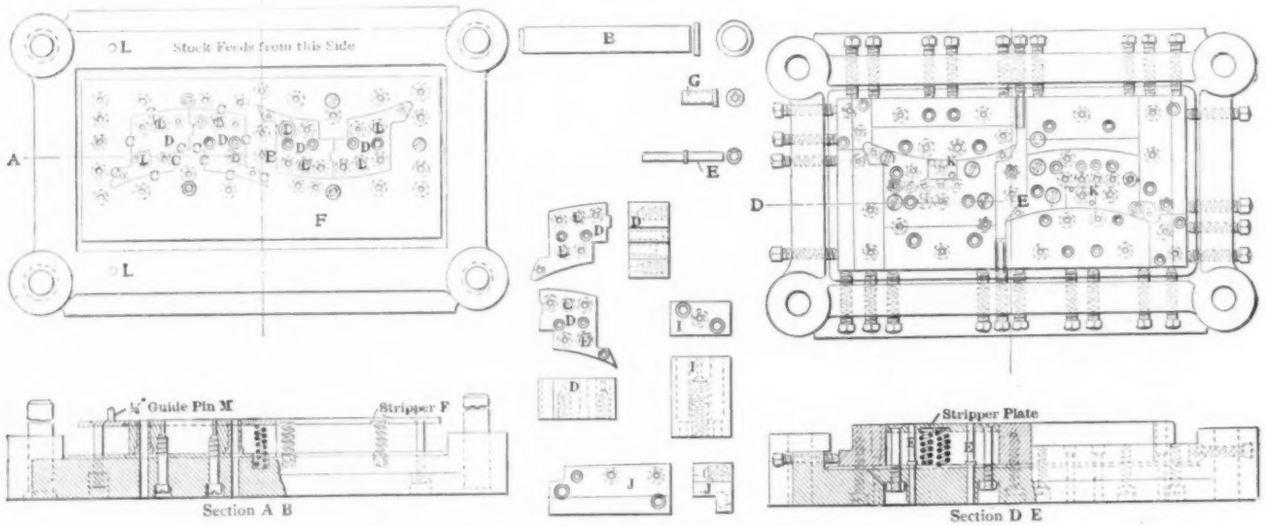


FIG. 2. THE PUNCH AND DIE FOR THE SECOND METHOD

Industrial Education

In my last letter I wrote about the Social Education Congress in Boston. Since then my curiosity, to say nothing of interest, led me to New York to attend the meeting of the A.S.M.E., and to hear Mr. Alexander's paper discussed. And right here I want to withdraw any hints that I may have given that Mr. Alexander's Boston address was in any way influenced by Beacon street. There is certainly nothing in the atmosphere of New York from Mott street to Fifth avenue to put a Back Bay hypnotism on any man, and Mr. Alexander was just the same in both places. The more I see and hear of him the more inclined do I become to believe in the man. This is no mere expedient worked up hastily to fill an immediate want. It is the result of a real and deep insight into the needs of all sides of the question, and Mr. Alexander is the first man to see, so far as I know, that there are three sides to it, and to put them in their correct relative positions.

A DISAPPOINTING CONTRAST

But to get back to the meeting. I was disappointed. I had seen the enthusiasm of the Social Congress and I thought, if these people, whose interest is only a distant, possibly a philanthropic, one, take so much interest, what must be the attitude of the manufacturers, the employers to whom this must come home? And yet there was no enthusiasm. Possibly the audience was so thoroughly baked by the intense heat that they could not think, but even then it would seem as if more men would have submitted written discussions. Two explanations are possible for this lack of enthusiasm; one that these men do not know what is going on, that there are trade schools and that there are to be more, do not realize that the social educator is about to take their work of teaching away from them; or else they prefer that the latter condition should prevail.

Mr. Higgins' discussion, reiterating his half-time school idea, aroused no enthusiasm. He has apparently changed his views in one important particular. Seven years ago he wanted all engineers to be educated up through his half time school. Today he is ready to dip into a stratum below the level of the embryo engineer for his material for engineers. Another of his conditions under which he would wish to see his school started is, that the class room instruction should be given by the public schools; but in conversation he has

given me the best of argument against this very proposition, and since Mr. Alexander and Mrs. Woolsman have both given me the same impression, I will state it here, not as a quotation from any of these people, but as an impression only.

THE PROFESSIONAL EDUCATOR NOT WANTED

The public school system, the colleges and the technical schools, are in the hands of professional educators. A professional educator is a man who has a college education and the college idea of education, which bears about the same relation to the problems of commerce and manufacture that training elephants does to breaking horses. Both are done on the same principles but for two distinctly different purposes. A professional man is a man who does his work as he thinks best without regard to any supposed knowledge on the part of his client. For instance, we summon a doctor and ask him to treat us for some imaginary ill. We must take what he gives or dismiss him. Just so with the professional educator. We may give him these boys for half time but must take what he thinks best in the way of studies or else fire him. This means that we will have to fire him. A totally distinct organization under the guidance of a man with the strength and the nerve to have taught what he knows from personal experience to be useful is the only organization that can produce results.

THE ALEXANDER IDEA AND THE TAYLOR IDEA

Whether it is considered treasonable for an outsider to criticize the president of the A.S.M.E. I do not know, but it seemed to me as if he was talking about something very different from what Mr. Alexander was discussing. Mr. Alexander is trying to make men—thinking, active, self-reliant men. Mr. Taylor's system must inevitably make men who can obey concise orders and turn out a vast amount of good work but who will not learn to think, because they do not have to and are not allowed to. Both are necessary in their places. Neither can be got by the method of the other. Mr. Alexander's men will be too ambitious to stoop to Mr. Taylor's jobs and Mr. Taylor's men cannot touch Mr. Alexander's jobs. Mr. Alexander's men will always be in demand. The whole force of social reform is being directed toward relieving men of the necessity of becoming Mr. Taylor's kind of men, mere machines. The condition of life where one picks up a certain size of shovel because someone tells him to, and spreads his feet so far apart and shovels just so fast for the same reason, no matter how it is paid for, seems to me to be a condition of life from which my soul would revolt. I would rather break a window and get sent up for 60 days at a time.

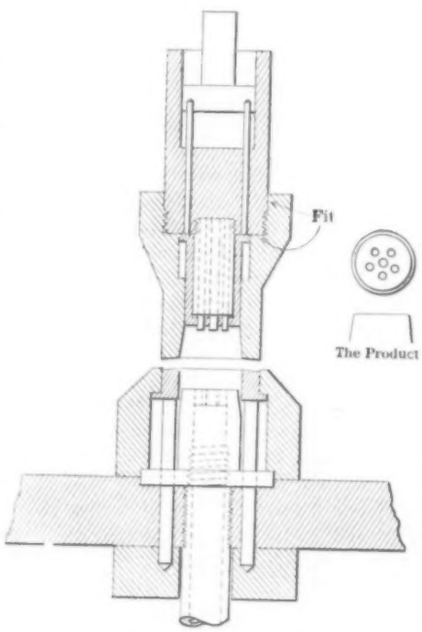
THE MANUFACTURER'S PART

And here is a danger. The enthusiasm of today in this matter lies with the social reformer. All well so far; but the social reformer is allied with the professional educator. And therein he makes a mistake which the manufacturer is able to correct if he will. These social reformers are going to get trade schools going. But they are not going to turn out the sort of man that the manufacturer needs unless the manufacturer takes a hand in the matter. They know what they want and have influence if they will use it. Get these trade schools governed by the sort of men who know what they want and they can get it. Let them use the enthusiasm of the social scientist but hold the purse themselves. If they do not they will have to wait years and years for these trade schools to get where they can give them the kind of men they need.

ENTROPY.

Die for a Sifting Top

One of the largest consumers of tin plate has found profit in the use of the single-acting punch and die shown herewith, and a few points in its construction are worthy of notice by die makers, as it is top-notch practice in its class. The product, as will be noticed, is a taper cup 15/16 inch diameter and 7/16 inch deep, of 100-pound tin plate, pierced with one No. 30 and five No. 35 holes. Wigglestick bluing caps is the name they appear under when in public, and they are really a sifting top for a paper tube of wash bluing. The taper was used as guaranteeing a fit somewhere, as the paper tubes varied considerably.



DIE FOR A SIFTING TOP

The center block has no special points, except the provisions for rechucking. The bottom and flange diameter are finished first, and the hole tapped out to the most convenient size and then finished by screwing against a freshly faced surface and truing by the flange. Thus the top face can be ground at any time to sharpen the piercing holes, without using a soldering iron, or boring out a piece of scrap, or sweating blood. The pressure ring is simple and should project slightly above the cut edge, and have enough flange to keep it at home; after hardening, the bottom should be lapped flat and then soldered to a freshly faced punch or other surface, and the bevel and hole ground, thus assuring parallelism. The bevel can be about 10 degrees where the draw is not too deep.

The punch was roughed from the back and had the fit and thread finished to size and cut off. The shank was then made to fit the punch, the punch screwed home and finished nearly to size, unscrewed, hardened, and then ground to size without moving the shank, which was then finished. The taper in the punch was made about ¼ degree less than that of the center block, to guarantee ironing out the body of the cap; the bevel was ground to fit the ring and the two were lapped together with flour emery and then polished nicely, particularly toward the center, as the outer edge tends to lap low. The wire edge must truly be a wire edge, as a very slight ridge decreases the depth of draw and increases the wear, and it must be burnished very smooth. To positively prevent body wrinkles, make the diameter of the drawing punch such that the draw is completed immediately past the wire edge, only enough to iron out flat; if too large, there is too much reduction after the ring loses its hold, and wrinkles will form. A thousandth over the double thickness of the stock is sufficient allowance. The piercing-punch holder was made and screwed in place, and the cast-iron bolster faced and counterbored to fit the flange of the center block, which of course had been drilled for screws and pressure pins. These should come under the working surface of the ring, not half way out on the flange, as often happens. The pin-plate made, the blank was found and then the six holes in the piercing-punch holder were located by leaving the punch down over a cap just drawn, carefully removing from the press and spotting in a speed drill. The cut edge was made entirely from the bottom, hardened and ground, leaving the bottom soft enough to take off a cut and counterbore to fit the flange of the center block. Thus the center block and die are always positively concentric and cups do not have a high side. The die should also hold down the center block and both are held to the bolster by flat-head screws, not shown.

The outside diameter of the punch should be eased off a few thousandths, leaving the land about ⅛ inch wide and a neat fit to the die. This saves wear on the die. The knockout should have enough action to positively knock out each cup, as two cups in one stroke means a new

punch. It is doweled to prevent turning, and is actuated by the ram knockout, as shown.

Three hundred and fifty thousand was considered a run with this outfit. By that time some girl had got in a piece of scrap and broken off a piercing punch or spread the drawing punch. Generally the repairs consist of grinding the top of the center block to sharpen the piercing holes, grinding the cutting edge, closing in the drawing punch while hot, upsetting and refitting and new piercing punches. The positive concentricity of the center block and cut edge is found a blessing over and over again, and the 10-degree bevel on the punch permits the die-setter to upset it several times before returning to the die shop for repairs. My recollection is that this outfit gave entire satisfaction.

SIRIUS.

Trimming Large Shells to Length

Recently I had to devise a cheap and quick way to trim a lot of drawn brass

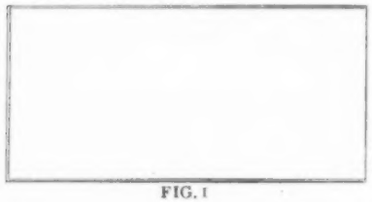
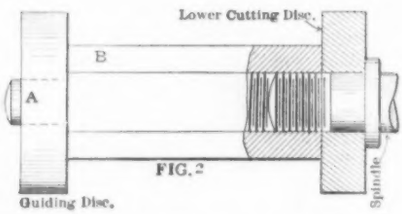


FIG. 1



TRIMMING SHELLS TO LENGTH

shells to a given length. These shells are about 4 inches bore and 6 inches deep when trimmed. I used a rotary shear for this operation. As the reader will know, the shearing is done by two hardened disks about four inches diameter. These are driven by means of a pair of shafts, held in such a way that the distance between their centers may be altered.

Removing the nut that holds the lower disk I fitted a substitute (see *B*, Fig. 2) tapped out at one end to suit the shaft. The other end is turned down and fitted to a disk similar to the cutting disks, but it is made of machinery steel, and is not hardened. Both disks on the lower shaft are an easy fit in the shells to be trimmed. The end *A*, Fig. 2, is the stop, and secures the correct length of the trimmed shell. This is all that is required to do the job.

In use it works in the following way: The cutting disks are screwed apart far enough to clear a shell; then a rough shell is pushed on the lower disks up to the stop; then the cutting disks are brought together, and the superfluous metal will be removed in double-quick time.

I should like to add here one or two cautions, to insure the proper working of this device. It is absolutely necessary that the cutting disks be ground to a sharp edge. The cutting disks should not overlap each other when trimming. Both these conditions are very necessary, or else a big bur on the trimmed edge will be the result. Fig. 1 shows the shell to be trimmed.

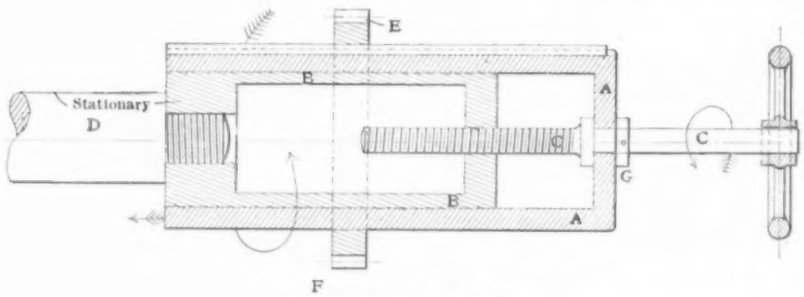
M. BODE.

An Interesting Little Problem for the Inventive Genius

Having followed with a great deal of interest and much benefit to myself Leicester Allen's problems, and noting the widespread interest taken in them by others, I thought possibly some of the readers of the AMERICAN MACHINIST would like to try their hands at a problem which came up to be solved in actual shop practice recently, and accordingly I submit it for their benefit as well as in the hope that some solutions will be forthcoming which will be better than the one I have adopted.

Referring to the illustration:

A is a hollow cylinder, 10 inches diameter and 20 inches long, and is revolved around the fixed cylinder *B* by means of an air motor located approximately in the space *F* and driving the gear *E*, which has no motion in the direction of its axis. The cylinder *A*, however, may slide back and forth through the gear *E*; it is rotated by the latter by means of a feather key extending the whole length of *A*.



AN INVENTIVE PROBLEM

B is a stationary cylinder screwed up tight on the stud *D*; it is cored out as shown in the cut, and is turned 8 inches diameter so that *A* will be a nice running fit on it. The outer end of the cylinder *B* has a hole in it threaded for the screw *C*.

C is a screw with a left-hand thread, eight threads per inch, screwed into the end of *B*, being a working fit in a hole in the end of cylinder *A*, which cylinder is compelled to move longitudinally with the screw by the collars at *G*, which take the end thrust, the part passing through the hole in *A* being turned 1 inch in diameter. By means of the hand-wheel on the end of the screw *C*, *A* may therefore be fed along *B* as desired.

Having explained the construction of these parts, I will now state the

PROBLEM

This consists in applying an automatic feed device so that the screw *C* will be driven from the cylinder *A*, the relative velocities being five revolutions of *A* in the direction of the arrow upon it to one revolution of *C* in the opposite direction, as shown by the arrow encircling the latter. This will result in *A* being fed along *B* 12 inches toward the left-hand side, that is, toward the stud *D*.

This mechanism must permit the operator's disengaging at will the screw *C* from the cylinder *A* without stopping the motor or the motion of rotation of the cylinder *A*. The motor which drives the gear *E* is not to be interfered with. The mechanism is to be attached to the end of the cylinder *A* and preferably not to extend beyond the diameter of *A*; if necessary, however, *C* may be increased in diameter or in length.

It is not necessary to make any provision for driving the screw *C* in the opposite direction, or, which is the same thing, for returning the cylinder *A* to the right. It is the intention to accomplish this return by disengaging the screw from the driving mechanism and returning the cylinder by hand.

O. B. SERVER.

The Inventive Microbe

Yes, Entropy, you may be sure that invention is the offspring of necessity—when it isn't the progeny of laziness.

When I first started the shop I bought a little second-hand steam engine to run it. If I remember rightly it was only 3 inches bore; at any rate it was so weak that when there was a cut on in the lathe the drill press could not be used. At first this didn't make any difference, as I was the whole show. But as Prosperity came down the pike she brought a red-headed, pimply-faced apprentice boy along with one hand (the boy had two hands—he couldn't have spoiled nearly as much work as he did if he had had only one); in the other hand (Prosperity's) she had a barrel of drop forgings, for bicycles, to be machined. At that time 1-inch tubing was the size used for bicycles. The first jig was finished and the drill press started, with Rufus in charge. Everything went

all right while I was showing him what to do, but when I left him and stepped over to the lathe and threw the shifter the plant stopped.

A CHILD OF NECESSITY

This was a nice mess—jigs to make in the lathe, a barrel full of forgings ready for the first operation, and a promise to be kept, upon which depended all the work that I, with my equipment, could handle. Obviously the plant stopped because it took more power than the engine could deliver. The shafting and machines could be moved easily with the thumb and finger on the main belt, so that part was as light running as could be expected. I suspected the thrust of the spindle on the quill of the drill press was considerably more than it ought to be, so I took a 1½-inch iron washer, chucked it and turned a groove in it and trued it on the back. Then I took another one, trued it on both sides and case-hardened them both. These were put on the spindle below the quill, with balls in the groove between them. The drill press was started, and with a heavy cut in the lathe I could not stall that engine by feeding a 1-inch drill into a machinery-steel forging. This ball thrust ran for years.

One day, when it was worn out and I was deliberating whether to make a new ball thrust or buy one from one of the many makers of these handy little devices, and before I had come to any definite decision in the matter, a salesman representing a ball-bearing concern dropped into the shop. I inquired whether his firm made ball thrusts for drill presses. What was my surprise when he replied: "We cannot make them, as the so-and-so company (I have forgotten the name) has a patent on ball thrusts for drill presses."

I then showed him the worn-out ball thrust and told him the date of its nativity. He asked me if I would be willing to swear to the age of this child of necessity, as it might come to an issue between his company and the company owning the patent on ball-thrust bearings for drill presses. Remember, this patent which these people owned (?) was a plain thrust bearing, not any peculiar form or design but its application to drill presses. How could such a patent hold?

TWO CHILDREN OF LAZINESS

You all know the story of the boy who tied the strings to the beam of the Newcomen engine and to the lever of the valve, so that the engine would work automatically and he could get time to play marbles. Those two cords put there by a lazy boy were the forerunners of the Beighton plug-rod gear used so extensively in later years.

There was in Camden, N. J., about 15 years ago a place where storage batteries were made. Among the machines used there was one that rolled a sheet of lead. As the sheet came from the machine a boy rolled it up. He was a lazy boy and, like many others who are lazy as far as physical exertion is concerned, he had an active mind. He devised and made a trough from an old soap box, which would automatically roll the sheets of lead as they came from the machine. Did *he* benefit from his invention? No—at least not for long. As soon as the superintendent saw the device he ordered one with rollers, an improvement on the original idea, and fired the lazy boy.

IS IT WORTH WHILE TO PAY FOR A SEARCH?

One of the best informed, and I think the most honest of all the patent attorneys I have ever had dealings with, told me that, in his estimation, $5 for a preliminary search was money thrown away, as the true search, the search that really found things and counted for or against the inventor, was the search by the examiners *after* the application was in. This may or may not be true. I know of one case in which I invented a little paper file. It was the neatest, slickest little thing I ever saw. I paid $5 for a preliminary search. The attorney sent me a copy of a specification in which was my paper file down to the minutest details, the shape of the spring, the curve on the ends, everything exactly like the model I had made. And the patent was 11 years old.

The followers of occultism assert that inventions are the result of thought waves sent out by the Yogi, who are boss telepathers resident in India. Whether this be true or not I do not know, but I have been told by patent examiners that they are often swamped with applications, from all parts of the country, for patents on precisely the same device, and that in their opinions there could be no possible chance of either collusion or stealing on the parts of the applicants.

Harking back to that paper file of mine, I guess if the Yogi theory be true that paper-file-thought-wave must have boarded a slow freight and got ditched on its way to me.

In the case of another thing I invented I had a search made and the attorney could find nothing to interfere with my getting a patent. When the examiners at Washington got hold of the thing, they cited so many patents upon which my device was an infringement, that it would have ruined me to be compelled to even buy all the specifications.

THE AVERAGE INVENTOR NOT AN INVENTOR

The trouble with most people who think they invent things is that they think they are inventors, and not mere adapters, which they really are. And how carefully they have to be handled! The only man that can handle the average inventor to his entire satisfaction is the jobbing-shop proprietor without a meal between him and starvation. Any old thing that comes into that shop is "the best ever," with "millions in it," and this is the kind of pap that these would-be revolutionizers of industry assimilate best.

A man rushed into the shop one day, just as I was weighing up the scrap brass to see if there was enough of it to buy supper that night and breakfast the next morning. He was all out of breath with his hurry, and when I got him calmed and he had recovered his wind he asked me if he could rely on my secrecy. Rely on my secrecy? Of course he could; I would have been willing to become a Trappist monk and take the oath of eternal silence for $5 (in advance). He then told me he had invented the greatest advertising device in the world, and pulled out a drawing of a common tricycle, with a tube sticking up straight in the middle in front of the operator. Hung from the top of this tube was a sort of skeleton drum which reached out over the three wheels, and down to within a foot of the ground. This skeleton was to be covered with canvas, on which was to be painted a series of advertisements. A connection from the driving gear was to revolve the drum slowly so that the ads. would be visible in succession from any point. Before letting me estimate on the job he gave me to understand that should I make any suggestions which the inventor could use I was to receive no pay for them. This I readily agreed to, and directed him to call later in the afternoon for the estimate.

At the appointed time he came, accepted my bid, and paid me 50 per cent. of the contract price. I immediately got a square meal and started in on the wonder. Some of the suggestions I made were received with applause and adopted, and others were rejected. When we were well on with the job I pointed out that as canvas was opaque he would have to adopt something else, or get a blind bicyclist to run the thing. Celluloid and mica were discussed and discarded. Then a brilliant idea struck me, one of those scintillating flashes of true genius (so common to me): "Why not use hen netting? You wish to attract attention. Think what a crowd-compelling attraction it will be to have a man inside that cage of hen netting on a snowy day, pedaling peacefully down the pike; a shout! a stinging *soaker* socks him in the eye or ear; in an instant the multitude's gaze is bent upon the adcycle."

"Fine!" he ventured, "fine; them words goes down in the specification."

The drum was driven at the top by a pair of bevels, the driver of which was connected to a diagonal shaft from the main driving shaft, near one of the side wheels. The connection between the driver pinion and the diagonal shaft was a flexible shaft, or, in other words, a common piece of steel-spring wire wound first right hand and then left hand back on top of itself. When this was tried it acted just like a twisted rubber band; it tied itself up in knots to an accompaniment of weird self-begotten melody not

unlike that made by a toy dulcimer. This the old man would not change.

The thing was eventually finished, the balance paid, and it was wheeled into the street. I never saw it again, but I heard that the inventor was "pinched" by a policeman fifteen minutes after he left the shop, for frightening horses, and that the adcycle finished its days, as a monument to his genius, on a dung heap in a livery stable, where the stablemen were exhorted by it to "Use Diana's bloom of youth for the complexion." DIXIE.

Training Skilled Workmen

While much has been written of late regarding the small number of skilled workmen seeking employment, no one has, as yet, had the courage to say that he found little trouble in securing skilled labor. It is therefore safe to assume that almost everyone is experiencing the same difficulty; and while some of the larger shops have taken up this matter with a view to filling their own future vacancies as they occur, there are a few things that must not be overlooked.

While I am not so foolish as to suppose that anyone is in the business of training apprentices for the benefit of some competitor, I do think that unless good care and judgment are used when young men have finished their apprenticeship this is pretty apt to prove to be what has been done. The reason for my saying this is due to the fact that, as a rule, the foremen in charge appear to have but little confidence in their own apprentices, which is very discouraging to the young man who is looking for an apportunity to show what he can do; and in a great many cases it induces him to seek employment elsewhere, where he can have the freedom of voicing an opinion once in a while, without being treated with that silent contempt which he is most likely to receive from the foreman who has had him in charge for four years.

Another question is that of wages; and I find in most cases that the shop in which a young man serves his apprenticeship is the lowest bidder for his services. And why? Because in most cases he is underestimated by his foreman who would rather take his chance on a stranger, so little confidence has he in his own apprentice. Some may argue that if a foreman does these things sooner or later he will be shown up, which will undoubtedly be true; but in the meantime how much injury has he done his employer and how many good men has he driven away, some never to return?

It appears to me that the question for the larger shops that have taken up this matter does not rest alone in educating apprentices but in keeping them, by showing a little more confidence in them and in offering them just compensation and a chance to see what they really can do, before letting them go to some competitor who reaps the benefit of another man's labor. APPRENTICE.

Combination Blanking and Forming Dies

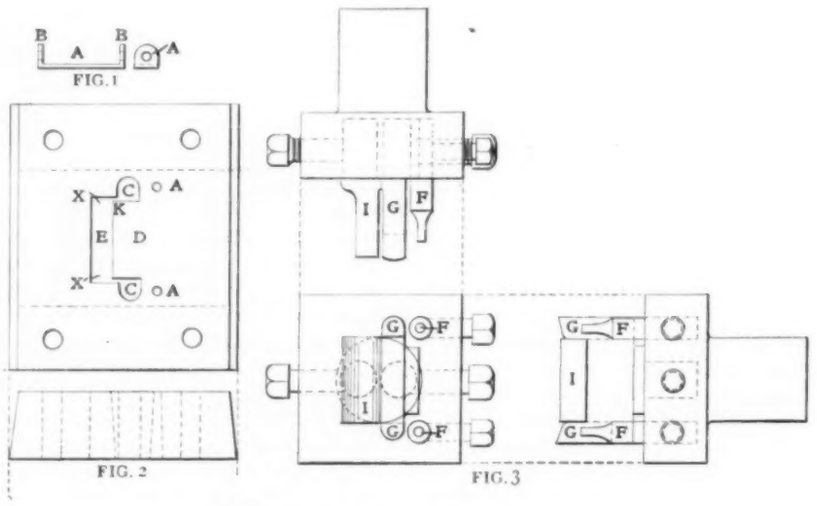
BY F. C. MASON

The piece to be made is shown at Fig. 1. The ordinary way to make this would be in two operations, one blanking and one forming.

The die is shown in Fig. 2, and the punch in Fig. 3. I do not show stripper or guides.

In the die four operations are performed in three movements. After the second movement a finished piece is made at each stroke of the press.

The first movement perforates the holes *A A*. The second movement blanks and forms the ears *B B*, and the third movement completes the blank and drops it through the die. There is a principle involved in this die that I have never seen in any other.



A COMBINATION BLANKING AND FORMING DIE

The piece is blanked and formed down at right angles in the opening *C*, the next movement it slides through the slot *D*, the ears *B* of the piece acting as their own stop against *X X* in the opening *E* in the die. By this method the pieces are fed in continuously with no danger of mistakes or the stop going wrong.

In Fig. 3 *F F* are the perforating punches, *G G* are the blanking and forming punches, and *I* the finishing punch.

When I designed this die there arose some discussion as to the probable action of the die at the point *K*, in regards to leaving a heavy fin on the finished piece.

The stock used was 16-gage soft sheet-steel, the pieces were 13/32 inch wide by about 2 inches long. The die worked perfectly, and the output was about 60,000 per 10 hours, using the roll feed.

Spiral Gears—An Error Corrected

In the article on Spiral Gears, by H. B. McCabe, at page 498, there is an error that is somewhat misleading. At page 499, first column, line 15 from top, it is stated that: "Using the same conditions, if the spirals were to be the same hand, etc." This should evidently read: Using the same conditions, if the spirals were to be *different hands*, etc.

Similar corrections apply to the article, Complete Graphical Solution of Spiral Gears, by E. H. Fish, at page 694; line 3, column 2 of this page, should read: and the spiral angles *F' B A* and *G' B C*, but of *different hands*, that is, one right and the other left hand, instead of both being of the same hand, either left or right.

At page 695, column 3, the last line in problem 3 should read: are of *different* hands, instead of "the same hand."

D. C. R.

[We have submitted the above to the authors of both the articles referred to, and they agree that the criticism is valid. —Ed.]

An 800,000-barrel cement plant, to be located on the outskirts of Montreal, Canada, for the Fordwick Company, will use about 2500 horse-power of electric motors and will take current from the Shawinigan power plant, 80 miles from Montreal. The property of the Fordwick Company is about two miles in length by 600 feet in width, along the St. Lawrence river. Provision will be made for storing adjacent to the works 40,000 tons of coal. The contract for the electrical work has been taken by W. S. Barstow & Co., of New York and Portland, Oregon.

Fire Chief Croker, of New York City, has been experimenting with an electric fire engine, which can take power from power circuits, trolley lines, etc., wherever it may happen to be located.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1906 *the* AMERICAN MACHINIST *printed and circulated* 1,083,205 *copies, an average of* 20,832 *per issue. Of this issue* 19,500 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Index

The index to Part 2 of Vol. 29 has been printed and mailed to all subscribers who receive their papers direct from this office. All other readers who may wish a copy of this index can obtain it free by sending postal-card request. It is a good, conscientiously made index and is well worth having. Send for it.

Commercialized Engineering

The *Evening Post*, of New York, published a short time ago an article under the above heading which is attracting a good deal of attention among engineers and has been reprinted and commented upon by a number of our technical contemporaries. The gist of it is that in electrical engineering there are practically but two great firms, and that these dictate the practice of the profession of engineering in the electrical field. The alleged result is the raising of almost insuperable barriers against new men with new ideas, and the practice becomes "routine and stodgy."

This result is brought about, it is claimed, partly by the arrangements these two firms have with capitalists. These arrangements are said to be such that people who propose to go into a new undertaking must first "secure engineering indorsement." This, it is claimed, really means the indorsement of the engineers of the particular one of the two concerns which is to "handle" the matter. This of course will mean that the standard productions of the firm concerned will be installed, and that no outside ideas will have any chance whatever.

There is, we believe, some basis of truth in this. Not that there is no competition, because there is such competition—plenty of it where smaller installations are to be dealt with; and probably there is pretty strenuous and genuine competition between the two large companies on most large undertakings that are "new business."

But it is certain that these companies do not constitute monopolies within the proper meaning of the term monopoly. Wherever an outside engineer or a group of outside engineers conceives of ideas in electrical engineering that are of real value and are patentable, there is nothing that we know of to prevent them from patenting them, raising capital and going into the market for business. So long as that can be done, there is no real or genuine monopoly. So long as that can be done those who are now in the business must conduct their business with a view to potential competition. That is to say, they must conduct their business with an eye to the fact that there is plenty of capital, brain and skill that will be brought into the business and into active competition with them if their terms to customers become too burdensome. Their position is scarcely comparable with that of the railroad monopolies, or of the steel or the anthracite-coal monopoly.

It is interesting to note in this connection that when the *Post* in its article comes to give a specific instance of the workings of the alleged monopoly it cites the New York subway roads, and particularly the cars used there. But this is a real and genuine monopoly. Cars with end doors only, through which opposing streams of people must work their way, to the great hindrance of the service, were not adopted because certain electrical firms in Schenectady and Pittsburg have a monopoly of their products, but because the New York subway is itself a monopoly and its owners can therefore consult their own interests solely.

The Automobile Engineer

In New York for a recent week the automobile reigned supreme. The machines on exhibition at the Madison Square Garden proved sufficient attraction for outside visitors, so that, together with those who for one business reason or another found it advantageous to be in town, they filled all the better hotels to overflowing. The fact that the hotels were much more crowded than they were during the horse show is being commented upon as indicating the relative decline of the horse in popularity. This, we think, is scarcely justifiable, for the number of people whose business in connection with exhibits brings them to New York during an automobile show is, of course, much greater than can naturally be the case with the horse show.

In fact, the business and manufacturing sides of the automobile exhibit the most stupendous and rapid growth ever witnessed. The machinist's art is practised for the most part for the production of things of utility. What he makes is mostly machines for producing things needed in the adequate production and transportation of materials from which our food, clothing and sheltering structures are fashioned. The automobile is, as yet, used almost entirely for pleasure, and by people who, when they desire pleasure from a thing, do not much mind the cost of it. Costs are now being more closely looked into—not necessarily first costs, but total costs per year, or per mile, for operating cars. Real engineering work is taking the place of empiricism and notion designing, or what might in some cases be called pipe-dream designing.

We have now the Society of Automobile Engineers, in whose meetings those interested may hear subjects of design discussed by real engineers. The writer, for instance, had the privilege of listening to two of the addresses delivered at a session of this society—that of Henri G. Chatain, on "Some Facts Pertaining to Electric Ignition," and of Henry Hess, on "Change Gears and Their Journals." Both were high-class papers, and though it

could have been wished that discussion had followed their presentation, those who listen to such papers can, at least, hardly fail to grasp the idea that there is such a thing as a science of machine design, and that a successful machine must, either by accident or intent, conform to the laws of that science. There has been in automobile designing far too much ignoring of these facts. Smart young men, with money but little else qualifying them to pass judgment upon things mechanical, have had too much to say about matters of design. It has been fortunate that most buyers who have suffered the consequences have been well able to do so, and we are approaching a period when almost any buyer of such a machine will get his money's worth with about the same certainty as he does when he buys machine tools, or engines. Which is not to say he will always and inevitably get his money's worth, but that he will do so more frequently than has been or is now the case.

The Profit-sharing Plan of the United States Steel Corporation

Our readers will recall the profit-sharing plan of the United States Steel Corporation, originally announced in 1902, by which preferred stock of the corporation was bought in by the finance committee and re-sold to employees, who were divided into classes and permitted to subscribe for specified amounts of stock based on their annual salaries, this amount varying from 20 per cent. of the annual salary in the case of those receiving the smallest salaries, down to 5 per cent. in the case of those receiving the highest amounts.

The original plan was to buy and apportion among the employees not more than 25,000 shares, but it appears that this figure has been very largely increased, the number of shares now held by the employees being nearly 125,000. Our understanding is that the original figure applied to the first year's operations, and that the offer has been repeated each year until the great aggregate now reported has resulted. The price each year has been based on, though it has always, we believe, been lower than, the market price at the time, and it has, of course, fluctuated from year to year. Originally the finance committee acted practically as brokers to buy in the stock and re-sell it to the employees, although at a rate previously announced. Whether this plan has been continued or whether recent sales have been of treasury stock we are not informed.

The original price at which the stock was offered was 82½, but since this price was made the stock has gone down to as low as 55 in 1904. At present, with the market at 106 and 107, announcement is made of a new offering to the employees at 102, this offer applying to nearly 200,000 men.

It appears that the stock now held by the employees has cost them about $9,800,000 and that its present market value is about $13,000,000, the result being a net profit, in addition to dividends, of about $3,200,000. The number and classification of the men by whom this great profit has been made is unknown to us. Needless to say such great holdings in the hands of its employees and such substantial gains to them are sources of material strength to the corporation.

Sammy's Shop—How He got It—The Early History of an Oil Country Establishment

BY W. OSBORNE

It wasn't much of a town, but such as it was its only excuse for being at all could be summed up in the word oil. Before oil was discovered the inhabitants were few and far between, and generally poor. About the only excuse a man had for staying in such a country was that he was too poor to get away from it. Lumbering along the streams was the principal industry and it had its ups and its downs. A winter with lots of snow—not too much at any one time—meant a busy one, and a good stage of water in the spring meant the ability to market the lumber. It was not a country for the farmer. Mountainous, rocky, and far from markets, it did not hold out many inducements to settlers until the wonders of oil began to interest all kinds of people.

AN OIL COUNTRY COMMUNITY

If enough people chance to be passing and meeting and coming and going at any place, it is not long before some of them get to staying there so as to do some of the many things needed by busy people. Away back in the early days these needs had been enough to establish a grist mill and a tavern at this point, and now there were stores and hotels, saloons and blacksmith shops, banks and a cemetery, churches and schools—or, to be more accurate in my statements about the latter two, church services were held in buildings which had been erected for very different purposes, and schools were held wherever the necessary room could be found. The town lock-up was for a long time in the front yard of one of the schools.

LOCAL MACHINE SHOPS

Among the other adjuncts of civilization were to be found two machine shops of some pretensions, and one small one. These, as well as the rest of the town, were housed in the cheapest sort of buildings, put up without any pretense of being anything but cheap.

It can readily be understood from the nature of the case that people were not planning things very far into the future. Oil was so new that it did not have an established place in the big plans of the world. There were no defined limits where it could be found. In fact it was largely a gamble all the way through. First it was uncertain where oil would be found, then it was uncertain as to the quantity, and the price was as uncertain as either of the other factors, for at times there was no market, while at other times it sold for several dollars a barrel.

STORY OF THE SHOP

It was of the machine shops that I started to tell. One of the large shops soon passed away with the other temporary things, while the other one developed some machinery that proved to be well adapted to the uses of the oil business, and although it changed hands a number of times it is still doing business. To be more accurate, one of the proprietors of it located a new shop in a better place in the town and put up good buildings and moved the machinery there. It was the little shop that more nearly represented oil country conditions. When I first knew it two men owned and ran it. That is to say, they owned the machinery and another man owned the building and the ground.

THE BUILDING AND GROUNDS

It is hard to imagine a use for which the building would have been suitable. To begin with, the ground was a swamp. To keep the floor dry the building had been set on posts about five feet long. Blocks, pieces of plank, stones, anything that happened to be handy, made the bottom supports for these posts. The floor joists might have been safe under a total load of fifty pounds to the square foot, but they did not look to be. The sides were made of boards stood on end. The roof was shingled, and there were a number of spots in it that did not leak. Two by six joists tied the lower ends of the rafters together and served to carry the line shaft.

SHAFTING AND EQUIPMENT

This line shaft was 1 15/16 inch in diameter. It was supported by boxes which rested on the joists, and had the very great virtue of being limber enough to follow the contortions of the building without breaking very often. It did break one time under conditions that nearly scared Sammy out of a year's growth, but that was some time after this.

The equipment of the shop—well, you are welcome to your own opinion as to that. On the long lathe they cut pipe—anything that was too big to be readily cut with the hand dies. As the hand dies were very dull, that often meant quite small sizes, especially if there was a lot of it. They bored cylinders on it. They turned things on it, and cut threads. Anything too large for the other lathe came to it, and lots of other things that were not too large came, if the other lathe was busy.

A HANDY OLD LATHE

The other lathe was smaller and shorter and older. If you saw the long lathe first you might be inclined to doubt this last statement, but it was true. Everything that would swing over the ways and go between the centers—and some things that would do neither—could be done on this lathe.

Just how good the job would be after it was done depended entirely on the skill, judgment and previous experience of the operator. Running this lathe was somewhat like riding a bucking bronco: it looked simple enough to the spectator; it was full of excitement to the operator, and the outcome was problematical. That good work could be done on it was proved by the fact that good work had been done on it.

OTHER ANCIENT TOOLS

The planer would take in a piece two feet wide and the table would travel six feet without running off. The drill press was an apparatus for revolving pieces of steel. Owing to the lack of rigidity and close fits to be found in every part of it, no great trouble was caused by holes drilled on it being too round or uniform in size. A stand on the bench, that took a 12-inch emery wheel with a 1½-inch face, and a small grindstone set in a wooden frame made up the grinding equipment. Then there were vises, bolt and pipe hand dies, a two-wheeled truck, dogs, pipe tongs, and an assortment of stuff which most people would classify as scrap but without which a machine shop would be a flat failure.

ESSENTIAL ODDS AND ENDS

Don't question this statement just because you have been raised, mechanically, in a laboratory and think it a model for a real shop if only the shop people had brains and push. In a photograph of some of the most modern machinery in use today, taken in the shops of the Midvale Steel Company, the thing that is most prominent is a lot of just such stuff. If such people as they are can't run without an accumulation of odds and ends, don't you ever be foolish enough to try it—that is, not in a machine shop. A factory might be different. They don't do things in factories; they just manufacture, which is different, too.

MOTIVE POWER—OIL MACHINERY

The motive power of this little shop was an engine and a boiler. The engine was little and the boiler was big, and both of them were old. They were not part of the shop in a sense, as they belonged to the owner of the building and the ground.

In those days, when the oil business was still new, all sorts of machinery were used in trying to get, handle and refine it, and much of it was not at all suited to the work. Inventors were busy, and many contrivances were devised that brought money to the inventor and saved it for the user.

THE INGENIOUS PARTNER

One of the owners of this shop got his mind on such matters and was constantly at work on something that would revolutionize things. Now it was a steam engine, again it was a pump, and then it might be a bung-hole borer for the barrel factory; but, whatever it happened to be, it kept his attention away from the repairing of the poor machinery that would break down. The fact that the owner wanted it repaired, more than he wanted to wait for the completion of some wonderful invention that would supersede it, did not have as much force as it should have had—or, at least, so it seemed to the owner of the broken-down machinery.

THE FRIENDLY PARTNER

The other partner knew that to get business he had to know people and have them know him. He believed in being friendly with everybody. He was friendly with the man who had just struck a gusher and wanted to let folks know it; with the man who had just put his pile into a dry hole and wanted sympathy in his misfortune; with the man who had just struck the town and wanted to get a line on things before making a break; with the man who had to hang around with nothing to do until the man he was waiting for showed up; and with a whole lot of fellows who were somebody today or might be somebody tomorrow.

GOODFELLOWSHIP OVERDONE

From time immemorial it has been the custom to break bread, among those who wish to be friendly; but, as the capacity of a man's stomach is limited in some places, that has been changed, so that now a liquid is substituted for solid food. That was the case in this place, and this partner spent quite a lot of his time partaking of this liquid representation of friendship and goodfellowship. The motive may have been good, but one of the fundamentals of science is that a body cannot be in two places at one and the same time. While this man was being so friendly he was not getting out the work, and it was work that people paid for. Even poor work was worth more, when it came to getting oil, than liquid friendship measured out by the glassful.

HARD TIMES

There came a time when the price of oil was very low, about 60 cents a barrel (a barrel of crude oil is 42 gallons), and everybody was blue. Work was at a standstill. The price had been steadily going down, and lots of people thought it would never go up again. The big shops were glad to take any little job that came along, so as to keep somewhere near making expenses, and the little shop was in a bad way. The money-making invention was still in the future, and the 44 degrees of goodfellowship were not paying dividends.

THE BUSINESS CHANGES HANDS

One man, who attended to business first, last and all the time, had his attention called to this shop and decided to take hold of it. This he did with his usual energy. The partners could not with their training and means withstand the thorough business methods of the other man, and it was not long before they found themselves without a shop.

This other man was the sheriff of the county. He did not believe in letting property lie idle in his hands, and it was only a short time before he had turned it and made his profit, and the property belonged to the owner of the land and building. He did not want it, but conditions had been such that he had to buy it, and as soon as he got it he began to plan as to how he could get rid of it—at a profit, of course.

SAMMY MAKES HIS APPEARANCE

Sammy was a machinist. He worked in one of the shops—when the shop had work, which was not always these times. He was a fair workman, young, healthy, sober, industrious and married. The owner of the building knew Sammy and thought of him among others as a possible purchaser of the elephant which he had on his hands. Sammy was used to hearing of how a man who works for others will never get rich, and of the immense profits made in the machine business. He knew that when he worked he got 25 cents an hour, and that the shop charged the other fellow from 45 to 60 cents an hour. Right there was a profit of from 20 to 35 cents, with a little bit of it out for running the engine and furnishing oil for the machines. He had seen a boy who worked for 10 cents an hour cut six pipe threads an hour, and the shop got 15 cents apiece for them.

BLISSFUL IGNORANCE

Sammy was young, and so was Mrs. Sammy. To them shop ownership meant wealth, dignity, standing in the community. They did not know much about the road they would have to travel before it brought them to all of these things. They did not know how long and rough and dark it often was, or how many hours a day they would have to travel to safely reach the desirable places along it. Neither of them knew that Mrs. Sammy would have to travel all the way along with Sammy, and, while it might be made easy for her in spots, at other places she would have to carry by far the heaviest part of the load.

THE EXPERIENCED SHOP OWNER

The shop owner was not a young man, and he was a man of affairs. He knew the road, and he knew that it took grit, tenacity and backbone to travel it. He knew that with all of these a man often needed something outside of himself to furnish the necessity for success. He had studied Sammy over just as he would study

any other business proposition over, and he believed that having Mrs. Sammy was a reason for Sammy's wanting to succeed that would keep him doing his very best. Perhaps you may think that he was a cold-blooded, selfish man; but remember that he was backing up his judgment with his money. He was willing to gamble on Sammy. It was a good thing for him, only if Sammy made a go of it.

SAMMY MAKES UP HIS MIND

It was a consideration of these things that finally decided Sammy. He had practically no money. He was to pay the rent after he had paid the other bills. He was to have all the work the other could throw his way. He was to have the use of the other's advice on business matters free for the asking, and he found this very valuable. He hadn't much to lose, for he didn't have steady work as it was, and he might have even less in the future.

It is said, "Time and chance come to all men," and this is the way it came to Sammy, and he started Sammy's shop.

W. OSBORNE.

The Big St. Louis Allis-Chalmers Engine Gets a Permanent Job in a New Plate-glass Factory

The Crystal City plant of the Pittsburg Plate Glass Company is now about completed at Crystal City, Mo., 28 miles below St. Louis. There are 15 buildings, all of reinforced concrete. It is estimated that 50,000 barrels of cement will be used in the building process, the brand being the "Universal Portland," made in the cement division of the United States Steel Corporation. Even the roofs are to be reinforced concrete tile, four feet by eight feet. Among industrial plants of its kind, this establishment is unique as being one of the largest in the country, and also as being remarkable because of the unusual size of the power and lighting units and motors for driving the machinery installed there. The power equipment already contracted for includes an 1800 brake horse-power Allis-Chalmers gas engine direct-connected to a 1000-kilowatt Allis-Chalmers generator. This unit will be installed in the same power-house with a 5000 horse-power Allis-Chalmers engine, which carried the entire lighting load for the illuminating of buildings and grounds of the Louisiana Purchase Exposition, at St. Louis, and was known there as the "Big Reliable," the name having been given it by the attendants because of continued good service during the entire duration of the fair.

Sixteen hundred horse-power in Allis Chalmers induction motors will be used to drive grinders and polishers.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A PRESS WITH SPECIAL FEED FOR CUTTING HACK-SAW BLADES

The illustration shows a press with automatic feed for cutting hack-saw blanks.

It has been found in making hack-saw blades with a slitting machine, that while the product was fairly good when the stock was thin, when thick stock was used a round edge appeared on one side of the blank and a sharp bur on the other. In making hack-saw blanks on the device shown, this undesirable feature has been eliminated.

The blade used is long enough to cut a blank the full width of the plate, or 20 inches. It has about ⅛-inch shear, cutting at the ends first.

The sheet of steel to be cut is clamped in a carrier on the feed table. This carrier is attached to two racks, one on each side of the feed table.

Depressing the treadle causes the slide to descend, operating a pair of pawls, which, in connection with the two racks on the carrier, advance the sheet the width of the saw blank.

The feed can be adjusted to advance the sheet ¼ inch to 1 inch at each stroke, varying by sixteenths. After the sheet has been cut up, the hand lever at the left side is raised to release the pawls and the carrier is pulled back into position by hand.

A PRESS WITH SPECIAL FEED FOR CUTTING HACK-SAW BLADES

A steel belt, not shown, is driven from the shaft above; the blanks fall on this and are conveyed to a box at the side of the press.

The sheet is held down by a very heavy

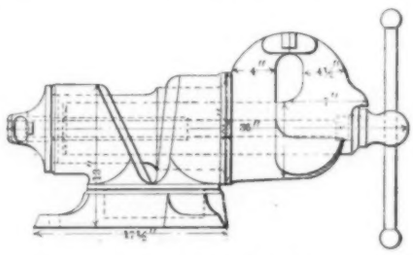
spring clamp which securely holds it during the cutting. This is shown in front of the shear blade.

The sheets of steel handled on this machine vary from 8 to 20 inches wide, and up to 28 inches in length, so that saw blanks from 8 to 20 inches in length can be made.

The fly-wheel, which weighs 500 pounds, is run sufficiently fast to cut from 60 to " strips per minute. The total weight of the press is about 2500 pounds. This press is built by the E. W. Bliss Company, 1 Adams street, Brooklyn, N. Y.

A DOUBLE SWIVEL VISE

The ilustration shows a double-swivel bench vise, which is supposed to be the largest vise in existence. While it is so large and weighs 695 pounds, the swivels can be turned by finger pressure. Work



A LARGE BENCH VISE

which is too heavy to be lifted from the floor may be tilted on end, and with the jaws swiveled at a right angle the work may be securely held. If the floor should happen to get tilted along with the work it makes no difference, for the jaws open wide enough to take the average floor in as well.

The jaws are 10½ inches wide and open 15 inches.

The screw is operated by hand, no power-traversing arrangement having been found necessary. The swivels are automatically locked by tightening the jaws on the work.

This vise is made by the Pittsburgh Automatic Vise and Tool Company, Pittsburg, Penn.

A CORE MACHINE

The illustration shows a core machine for making round, square or other shaped cores from 3/16 inch to ¾ inch in diameter by 14 inches long. By using a mixture of charcoal, plumbago and oil, cores as small as 1/16 inch diameter can be made. The core material is fed to the plunger by means of a screw, the plunger ramming the core to the desired consistency. The regular equipment permits round cores from 3/16 inch to ¾ inch, rising by 1/16 inch, to be made. Three core plates, which pile one on top of the other, are also furnished. These are shown filled with cores at the back of the machine.

This machine is manufactured by the Diamond Clamp and Flask Company, Richmond, Indiana.

AN ELECTRIC DRILL FOR SMALL WORK

The United States Electrical Tool Company, Cincinnati, Ohio, has brought out an electric drill, capable of drilling holes 3/16 inch diameter and less, and weighing only six pounds.

New Publications

"Tools for Machinists and Woodworkers." By Joseph G. Horner. 340 5½x8-inch pages with 456 illustrations. The Norman W. Henley Publishing Company, New York. Price, $3.50.

This book is a general treatise on the principles and construction of cutting tools for both wood and metal. Nearly all the tools used by wood and metal workers are classified and described and their action is explained.

"The Slide-Rule." By Chas. N. Pickworth. Tenth edition. 104 5x7-inch pages with 22 illustrations. Emmott & Co., Manchester and London. The D. Van Nostrand Company, New York. Price, $1.

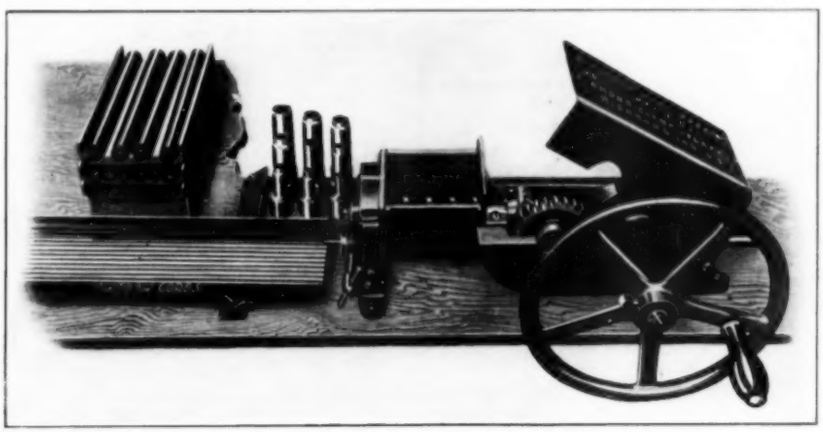
The continued demand for Mr. Pickworth's manual of the slide-rule is the best evidence of its value. In addition to a full explanation of the principles and operations of the rule, it contains a 3½-page table of conversion factors, and a large number of examples of technical calculations in mechanical and electrical engineering, together with various trigonometrical applications of the rule. It is especially full in its description of unusual and special forms of rules and attachments for them. Several of these are not made in this country; but on the other hand some forms, which are quite common here, are not included in the book.

"Amerikanische Eisenbauwerkstätten." A report compiled by Prof. Dr. of Engineering H. Reissner, Construction Engineer at the Königliche Technische Hochschule, Berlin. Berlin: Published by Richard Dietze, 1906; 75 pages, 10½x15¼ inches, denim boards. Price, 12 marks.

This is a report of a study of American bridge and structural steel shops, made by Professor Reissner, who spent considerable time in this country for the purpose, part of it in the employ of some of the manufacturers. The book is divided into two parts: the first discusses common characteristics, and the second contains descriptions of individual plants. In the former, materials and economical questions are considered, the number and capacity of the plants, the form of organization and discussion of the different departments, and the general layouts of the workshops and their equipment. The illustrations include very clear plans of works, details of construction, cranes and other devices, and many illustrations of the machines used in this class of shop. The book should be very valuable to anyone making a study of this matter.

"Modern Milling Machines. Their Design, Construction and Working." By Joseph G. Horner. 304 6x9-inch pages, with 269 illustrations. The Norman W. Henley Publishing Company, New York. Crosby, Lockwood & Son, London. Price, $4.

Of the author's numerous books this is the most interesting that we have seen—largely, perhaps, because it deals principally with American machines, and because it gives some account of the historical development of the milling machine. On one of the early pages we find an illustration of what is believed to have been the first milling machine—a simple little affair which was unearthed by the late E. G. Parkhurst, whose name is well known to our readers. The origin of the Lincoln, as the first well developed type of milling machine, is gone into, and a little later on we find the first universal milling machine, the one exhibited by the Brown & Sharpe Manufacturing Company at the Paris Exhibition of 1867. The illustrations are very numerous and give in great variety of detail the construction of many milling machines which are familiar on this side of the Atlantic, as well as of others of English and continental European make. A number of typical jigs and fixtures are shown and a chapter is devoted to feeds and speeds.



A CORE MACHINE

Personal

Frank P. Allen, Jr., manager of the General Engineering and Construction Company of Seattle and Portland, and an architect and engineer of wide experience, has been appointed director of works of the Alaska-Yukon-Pacific Exposition, which will be held at Seattle during the summer of 1909.

E. R. Yeisley recently resigned his position as general foreman of the tool room of the Western Electric Company's plant, at Chicago, Ill., to accept a place with the National Cash Register Company, Dayton, Ohio. He was presented with a diamond pin by his associates at the electric works, as a token of their esteem and good wishes for his continued success.

H. J. Lamborn, for the past four years mechanical engineer and superintendent of the magnetic separating plants of Witherbee, Sherman & Co., at Mineville, N. Y., and for several years prior to 1901 connected with the engineer department of the U. S. A., has been appointed superintendent of power and plant in the Yale & Towne works at Stamford, Conn., to succeed F. A. Waldron, who resigned about a year ago. S. E. Dauchy, who has been acting superintendent of power and plant during the past year, and for several years has held the position of assistant superintendent, will continue in the latter capacity under Mr. Lamborn.

Obituary

Chief Engineer Burdette C. Gowing, U. S. N., retired, died January 12 at Tully, N. Y., his birthplace, aged 68 years. He was educated at the Rensselaer Polytechnic Institute of Troy, and entered the naval service as a third assistant engineer in October, 1861. He saw much service during the Civil War, and in 1866 was commissioned chief engineer. He was placed on the retired list in 1895, owing to physical disability.

John Scott, one of the best known mechanics in New England, died at Lowell, Mass., January 2, at the age of 72. Mr. Scott learned the machinist's trade in the Lawrence Machine Shop at Lawrence, Mass., and as soon as he had completed his trade he went south and engaged with the North Carolina Central Railroad, where he remained until the breaking out of the War of the Rebellion. Returning north, he connected himself with the Lowell Machine Shop, and had charge of the locomotive department while there. In 1878 he became superintendent and mechanical head of the great thread mills of the Willimantic Linen Company, at Willimantic, Conn. He retired from his position a few years ago and since then had resided in Lowell.

Business Items

The Birdsboro Steel Foundry and Machine Company, Birdsboro, Penn., report a large demand for their cast-steel car bodies, steel body ingot cars, Wagner cold saws and O. H. steel pipe fittings.

The Latshaw Pressed Steel and Pulley Company, of Allegheny, Penn., are rapidly increasing their facilities, and are adding another floor to their plant. They are also introducing new and special machinery, and report a very lively demand for their steel pulleys.

The Canadian branch of the Lumen Bearing Company, under the management of N. K. B. Patch, is now located in its new foundry at Toronto Junction. This is equipped especially for foundry work, with a capacity for 7000 pounds of castings a day. The company will continue to make its Lumen bronze as well as manganese bronze, brass and aluminum castings.

In order to handle to the best advantage the increasing business in that section, the Pittsburgh Automatic Vise and Tool Company, manufacturers of the Pittsburgh double and single swivel automatic vises, Pittsburg, Penn., opened on January 1, a branch office in the Schoefield building, Cleveland, Ohio. This company proposes to carry a well assorted stock of all kinds of vises constantly on hand.

Manufacturers

The Parker Pen Company, Janesville, Wis., will build a new factory.

The Nevada Sheet Metal Company, Reno, Nev., will erect a new plant.

The Remington Oil Engine Company, Stamford, Conn., will build a plant.

The Trumbull Electric Company, Plainville, Conn., is to build a new factory.

The Leatheroid Manufacturing Company, Kennebunk, Me., will enlarge its plant.

The Allen Machine Company, Beverly, Mass., is fitting up its new four-story addition.

An addition to the plant of the Diamond Rubber Company at Akron, Ohio, will be built.

A boiler and engine house will be built for the Lenten Brick Company, Philadelphia, Penn.

The National Refining Company, of Dubuque, Iowa, will erect a plant in Mankato, Minn.

Crenshaw Bros., Tampa, Fla., will erect a new ice and cold storage plant at a cost of $50,000.

The A. Buck's Sons Company, Elizabethtown, Penn. is building an addition to the foundry.

The Hecla Cement Company, Bay City, Mich., will build an addition and install new machinery.

E. B. Delamater, Poughkeepsie, N. Y., will erect a three-story carriage and automobile factory.

The Crystal Ice and Storage Company, Buffalo, N. Y., has filed plans for a new ice-making plant.

The Beaumont (Texas) Ice, Light and Refrigerating Company will erect a new cold-storage building.

The Birdsboro (Penn.) Steel Foundry and Machine Company will build an addition to its power plant.

Plans are being prepared for a refrigerating building for the Valentine Bohl Company, Waterbury, Conn.

The Worcester (Mass.) Textile Machine Company has organized as a corporation and will enlarge the plant.

The plant of the Detroit Register Company at Milan, Mich., which was recently burned, will be rebuilt.

The J. Randall Williams Company, of Philadelphia, Penn., will build a large lumber plant at Salisbury, N. C.

It is reported the Perkins Machine Company, Warren, Mass., is considering the matter of enlarging its plant.

The Excelsior Steel Ball Company, Buffalo, N. Y., is erecting an addition to be used as a forge and machine shop.

A permit has been issued to the Washington (D. C.) Terminal Company for a power house at the Union station.

The American Steel and Wire Company will spend over $500,000 on improvements at its plants in Worcester, Mass.

Leroy S. White is forming the White Forging Company in Endicott, N. Y., which will put up a plant to cost $40,000.

Contract for the erection of car shops for the Pittsburg & Butler Street Car Company, at Mars, Penn., has been awarded.

Burns, Silver & Company, Bridgeport, Conn., manufacturers of brass goods, will double the capacity of their plant.

The Crystal Ice and Storage Company, Buffalo, N. Y., will put up a new building to be used as an ice-making plant.

Two new buildings will be erected at the plant of the Schuylkill Bridge Works, Pottstown, Penn., one to be a rivet house.

The Delaware, Lackawanna & Western Railroad Company will build locomotive shops in Scranton, costing about $2,000,000.

The W. H. Page Boiler Company, Norwich, Conn., will move to western Pennsylvania where a large plant is being erected.

Fire destroyed the box factory of the Russell-Kress Company, McKees Rocks, Penn. Loss $52,000. The company will rebuild.

Robert M. Green & Sons, manufacturers of soda fountain apparatus, Philadelphia, Pa., have taken out a permit for a new $20,000 factory.

Dr. Frederick J. Wearne, proprietor of the Wearne foundry, Omaha, Neb., will erect a new three-story foundry to replace the present one.

The United States Steel Corporation is planning to build a $25,000,000 plant on the Canadian side of the Detroit river below Sandwich.

The Success Manufacturing Company, Gloucester, Mass., will erect a new factory to be used for the manufacture of sheet metal specialties.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers. 75 Broad St., New York.

Caliper cat. free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Drafting, designing special machinery. Edw. F. Chandler, 35 Frankfort St., N. Y.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

In answering ads. use my Qualification Form; sample 20 cents. Box 555, AM. MACH.

Wanted—The address and catalogs of manufacturers of magnetic clutches. Box 548, AMERICAN MACHINIST.

Special machinery to order, inventions developed. Geo. M. Mayer, M. E., 1131 Monadnock Bldg., Chicago, Ill.

Shafting straighteners, rolls to flatten wire, back volume of AMERICAN MACHINIST. J. H. Wells, Tampa, Fla.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

$1.50 per dwt. for clean platinum scraps; send by registered mail for safety. National Refinery, 239 Taylor Ave., Newport, Ky.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACH.

Inventions perfected, drawings and models made, patents obtained, machinery developed. Mechanical expert, Box 554, AMER. MACH.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

Wanted—One 42x42x14 heavy planer, two heads on cross rail; latest, heaviest design. Second-hand tool will be considered if absolutely in first-class condition. Curtis & Co. Mfg. Co., St. Louis, Mo.

Wanted—Cleveland aut. screw mach. 1½″ to 3″; Bardons & Oliver hand screw mach. 1¼″ to 1½″; metal saw cut off mach. 16″ to 24″ saw; boring and turning mill 40″ to 50″. Box 413, AMERICAN MACHINIST.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Not using the whole of our modern factory plant, we should like to take up the building of any small high-grade machines, or parts of machines, in large or small quantities. United Sewing Machinery Company, Springfield, Mass.

Manufacturers' agents: parties with twenty years' experience and thoroughly posted on general manufacturing and business conditions in New England desire to handle A-1 specialties or staples on commission basis; have established Boston offices in central location and can offer highest possible references. Address P. O. Box 3117, Boston, Mass.

Business Opportunities

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Astall Iron Works, machine-shop plants, established 40 years. Jesse Astall, Galveston, Texas.

For Sale—Two second-hand cupolas in first-class condition; shells 72″—82″ in diameter and about 40 feet high. Box 333, AM. MACH.

For Sale—1 Farrel milling machine attachment for planers; practically new. Standard M. C. Co., 172 Whiton St., Jersey City, N. J.

For Sale—Cyclopedia of modern shop practice four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O. Box 425, Chicago, Ill.

For Sale—Two 14x6 Flather back geared screw cutting lathes; one 14x6 Prentice machine lathe; one Pratt & Whitney overhung arm milling machine; one Pratt & Whitney power do.; one Pratt & Whitney hand feed do.; one Brown & Sharpe universal speed lathe; three Grabo speed lathes; one Prentice radial drill press; all in first-class condition. Page Machine Co., 812 Greenwich St., N. Y.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Draftsman—Engineer in charge of large drafting room in the West wants work in the East. Box 546, AMERICAN MACHINIST.

INDIANA.

Superintendent; northern man; technical education; practical mechanic, familiar with modern methods of manufacturing tools, jigs, high-speed steels; wishes to become permanently connected in the South; am employed; best references. Box 549, AMERICAN MACH.

Superintendent; man; employed; thorough practical mechanic; technical education; familiar with manufacture of small and medium size interchangeable parts, the use and design of tools and jigs and high-speed steels. Past positions—inspector, assistant superintendent, superintendent, best of reference. Any location. Box 550, AMER. MACHINIST.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MASSACHUSETTS

Draftsman and designer, now employed, wishes to change; accustomed to automatic and special machinery; prefer Boston or locality. Box 551, AMERICAN MACHINIST.

Machinist, toolmaker, designer of dies, jigs, fixtures, etc. Organizer, shop foreman, now superintendent, 14 years' general experience; good references and education; age 31. Box 431, AMERICAN MACHINIST.

MICHIGAN

Brass foundry foreman desires a position; experienced in power and hand molding machinery, and modern system of melting metals; first-class reference. Box 542, AM. M.

NEW JERSEY

Foreman; 20 years' shop practice; 10 years' experience on duplicate manufacturing of machinery and tools, desires a change; New York or vicinity; Box 544, AMER. MACH.

Foreman toolmaker, up to date in dies, jigs, and speedy appliances; also in handling men; can give best of references. Box 539, AMERICAN MACHINIST.

Position as superintendent, purchasing agent, or manager, thoroughly practical engineer, now holding responsible position. First-class references as to character, business and mechanical ability. Box 510, AM. MACH.

Position as advertising or sales manager by mechanical engineer with 12 years' experience in office, drafting room, shop, and selling. Has thorough mechanical training, knowledge of advertising, good command of English, and is a clear, concise correspondent. Is a high-grade man and will consider only first-class offer. Address Box 497, AM. MACH.

NEW YORK

Superintendent or master mechanic desires change; first-class references and experience on hard problems. Box 416, AMER. MACH.

Assistant mechanical operating engineer; Pratt Institute graduate, three years' experience, desires change. Box 557, AM. MACH.

Toolmaker and machinist who has had some road experience wants position as traveling salesman. Box 556, AMER. MACHINIST.

Mechanical expert and superintendent desires position where skill, technical and business training may be put to good use. Box 553, AMERICAN MACHINIST.

Young draftsman desires change of position. Engineering office, with chance of advancement; New York city preferred. Box 541, AMERICAN MACHINIST.

Mechanical engineer, experienced designer on automobile, marine and stationary gasolen and oil engines, is open to engagement. Box 508, AMERICAN MACHINIST.

Experienced mechanical draftsman, technical graduate; 7 years chief draftsman with manufacturing concern; desires position south or southwest. Address, Box 538, AM. MACH.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

OHIO

Position as tool room foreman or master mechanic by A-1 mechanic with 24 years of practical experience in most all classes of tool work. I am capable in reducing cost in manufacturing. At present employed. Box 535, AMERICAN MACHINIST.

PENNSYLVANIA

Chief draftsman, general mill work, wishes position as chief draftsman or assistant superintendent. Box 417, AMERICAN MACH.

Expert inventor and designing engineer, age 36, 19 years' experience, shop practice, technical education, wishes to better; Ohio or Pennsylvania. Box 543, AMER. MACH.

A college graduate with 10 years' experience, as chief draftsman, manager of works office and systematizer wishes position; first-class references. Box 547, AMER. MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Patternmaker as working foreman small shop in eastern city; state age, experience and pay expected. Address "Eastern," Care AMERICAN MACHINIST.

Machinists wanted—Lathe, drill press and bench hands, to work on tools and automatic machines, give full particulars. The Boesch Mfg. Co., Danbury, Conn.

Wanted—Good all-around machinists familiar with heavy work; steady work and good wages. Apply at once, Farrel Foundry & Machine Co., Ansonia, Conn.

Wanted—An experienced machinist to act as foreman of a machine shop in the country. State age, experience, and wages wanted. Address, Box 536, AMER. MACH.

Wanted—One or two good men for our drafting room. Must have shop experience. A good chance for a quick and industrious young man. Write at once to The Torrington Mfg. Co., Torrington, Conn.

INDIANA

Wanted—Lathe men, tool makers, and machinists. Good wages; steady employment; increasing force. The Western Motor Co., Logansport, Ind.

Wanted—High-class designing engineer for rotary engines; salary $5000 to $10,000 per year to man who has had definitely successful experience. Reply care Box 545, AM. M.

Wanted—A draftsman; gas works apparatus and plants, by a contracting firm in Indiana. Tech. graduates of several years' shop or gas works experience preferred. Address "K," Care AMERICAN MACHINIST.

MASSACHUSETTS

Experienced mechanical draftsmen wanted for permanent position with General Electric Co., Lynn, Mass. Send full particulars regarding age, education, experience and salary expected to Engineer in Charge Drawing Office, General Electric Co., West Lynn, Mass.

Wanted—Foreman on high-grade automobile work; familiar with modern shop methods; capable of producing results and handling men; successful applicant must show experience in this line; state fully experience, give reference, age and salary expected. Location western Massachusetts. Address "S. P.," AMERICAN MACHINIST.

Ambitious young man familar with blanking presses on small brass products, preferably a foreman with experience in handling help and marked executive ability in laying out work and producing a perfect product; a hustler with a fair education. Start at $3 a day, as inspector, preferably a man who is now earning more money and making a success of his job. To the right man opportunity open to advance as rapidly as competent to $1800 to $2500 salary. Give details of experience and employers for several years past, minutely describing the kind of work turned out and the wages received, all of which will be considered confidential. Location, eastern Mass. Box 540, AM. MACH.

NEW JERSEY

Wanted—At once, two good machinists. Apply by letter or in person to Waldrich Bleachery, Delawanna, N. J.

Wanted—Mechanical draftsmen on small tool and jig work; state age, experience, references and salary expected. Box 503, AM. M.

Screw machine operators wanted on automatics; Acme, Pratt & Whitney or Spencer. Able to set up jobs. Steady work. Highest wages. Mack Mfg. Co., 401 St. Paul's Ave., Jersey City, N. J.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work, steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady

work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Draftsmen capable of designing tools for small interchangeable work. Write, giving experience, age and salary expected. Address: Box 434, AMERICAN MACHINIST.

Wanted—A number of first-class lathe, planer, slotter and boring mill hands, for both day and night shift. Steady work and good wages. Apply to Ingersoll-Rand Co., Tarrytown, N. Y.

Wanted—Several first-class mechanical and electrical draftsmen. Apply, giving age, experience and salary expected, to engineer in charge, drafting department, General Electric Company, Schenectady, N. Y.

Wanted—Young man to handle orders and invoices, must be good writer and familiar with materials used in machine shop. State experience, give reference and state salary desired. Box 425, AMERICAN MACHINIST.

Foreman wanted for machine shop making gasolene engines, etc., ten men employed now, but increasing plant, must be all-around man understanding up-to-date methods, location near New York City. Box 537, AM. MACH.

Mechanical engineer; technical graduate with experience in installation of machine tools, millwright and steam fitting, as supervising mechanical engineer in the maintenance department of a large manufacturing company in New York City. Give full particulars as to experience, references and salary expected. Address Box 552, AM. M.

Wanted—A competent, reliable, trustworthy superintendent to take complete charge of manufacturing business in Greater New York. Must have a thorough technical education. Class of machinery used in our production consists of lathes, planers, boring mills, grinding mills, milling machines, etc.; all modern machinery in every respect. For the right party we have an excellent permanent position. Those who are not qualified fully to the conditions herein stated need not reply. Answer, giving full particulars, references, wages expected, etc. "Up-to-date," AM. MACH.

OHIO

Wanted—First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 388, AMERICAN MACHINIST.

Wanted—A first-class toolmaker who has had experience in experimental machine tool work and who is capable of perfecting uncompleted brass finishing tools. Write giving references and stating terms. Buckeye Iron and Brass Works, Dayton, O.

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Wanted—General foreman for machine shop, employing 400 men, located in western Pennsylvania. Box 495, AMERICAN MACH.

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Wanted—A draftsman with experience in designing jigs and fixtures for machine tools. State experience and salary desired. Box 496. AMERICAN MACHINIST.

Wanted—Instructors in mechanical and electrical engineering; technical graduates with some years' experience. Address Box 415, AMERICAN MACHINIST.

Wanted—First-class machinists for floor work; must be capable of erecting machines outside the shop and demonstrating; state actual experience in such work. Apply to Stoever Foundry and Manufacturing Co., Myerstown, Pa.

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To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.

Chucks, Drill—*Continued.*

Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co. Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Reed Co., Francis, Worcester, Mass.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

National Tool Co., Cleveland, O.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers

Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic

Sturtevant Co., B. F., Boston, Mass.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.

Compressors, Air—*Continued.*

General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.
Skinner Ship. Bldg. & Dry Dock Co., Baltimore, Md.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveying Machinery, Automatic

Lamson Consol. S. S. Co., Boston, Mass.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Correspondence Schools

See Schools, Correspondence.

Corundum

See Grinding Wheels

Cost Systems

American Mechanical Calculator Co., Cincinnati, O.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.

Couplings, Shaft—*Continued.*

Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.
Williams Valve Co., D. T., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuue, Iowa.
Becker - Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Works, Philadelphia, Pa.
Nutter, Barnes Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

"Whitney" Chains

In 1907 will break all previous records for durability

We are moving into our new fire-proof factory building and will operate both plants, old and new, until we are fully settled so our production may be steadily increased with no interruption.

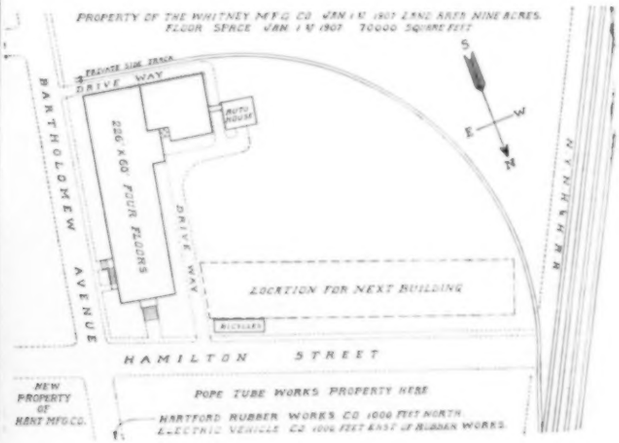
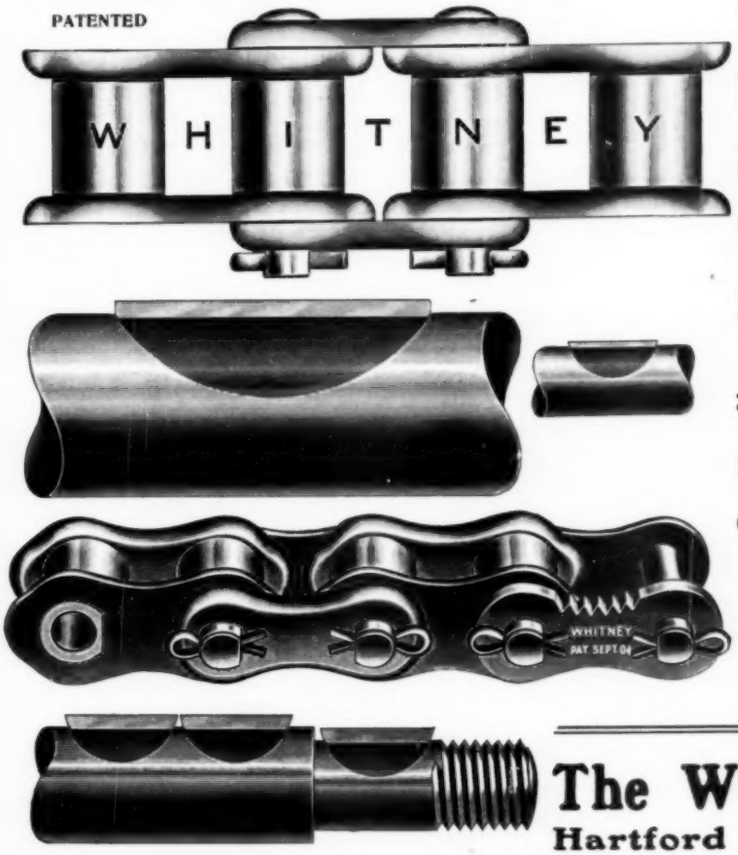

PROPERTY OF THE WHITNEY M'F'G CO. JAN 1 '07 1907 LAND AREA NINE ACRES
FLOOR SPACE JAN 1 '07 1907 70000 SQUARE FEET
PRIVATE SIDE TRACK
DRIVE WAY
AUTO MUSEUM
226 X 60 FOUR FLOORS
DRIVE WAY
BARTHOLOMEW AVENUE
LOCATION FOR NEXT BUILDING
HAMILTON STREET
NEW PROPERTY OF HART MFG CO.
POPE TUBE WORKS PROPERTY HERE
HARTFORD RUBBER WORKS CO 1000 FEET NORTH
ELECTRIC VEHICLE CO 1000 FEET EAST OF RUBBER WORKS
S
W
E
N
CONNECTICUT RIVER

PHOTO. TAKEN JANUARY 6, 1907

This cut gives an idea only of the plant which we believe will be the finest and most complete in existence for the manufacture of High Grade Driving Chains.



"Whitney" Chains

HAND AND WEIGHT FEED MILLING MACHINES, and The Woodruff Patent System of Keying

are Standard with most American Builders of Automobiles, Commercial Cars, Machinery, etc.

The Whitney Mfg. Co.

Hartford Connecticut

Cutting-Off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Co., Springfield, Ohio.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal

Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Kent & Co., Edw. R., Chicago, Ill.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press

Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Rich, J. & G., Phila., Pa.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
American Tracing Cloth Co., New York.
Derry-Collard Co., New York.
Keuffel & Esser Co., New York.
Rich, J. & G., Phila., Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers

Ingersoll-Rand Co., New York.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Boiler

American Tool Wks. Co., Cin., O.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote, Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Drilling Machines, Multiple Spindle—*Continued.*

Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fichburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret

Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote, Burt & Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knight Mchry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.

Drilling Machines, Upright—*Continued.*

Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center

Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic

Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Electrically Driven Tools and Machinery—*Continued.*

U. S. Electrical Tool Co., Cincinnati, O.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-room

Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances

Lunkenheimer Co., Cincinnati, O.

Engineers, Consulting, and Mechanical

Dodge & Day, Philadelphia, Pa.

Engineers, Electrical

Crocker - Wheeler Co., Ampere, N. J.
Dodge & Day, Phila., Pa.

Engines, Automobile

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jacobson Mach. Mfg. Co., Warren, Pa.
New Era Gas Engine Co., Dayton, O.
Olds Gas Power Co., Lansing, Mich.
St. Marys Mach. Co., St. Marys, Ohio.
Struthers-Wells Co., Warren, Pa.

Engines, Steam

Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers

Bormay Engraving Co., New York.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube

Nicholson & Co., Wm., Wilkesbarre, Pa.

Fans, Electric

Crocker - Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

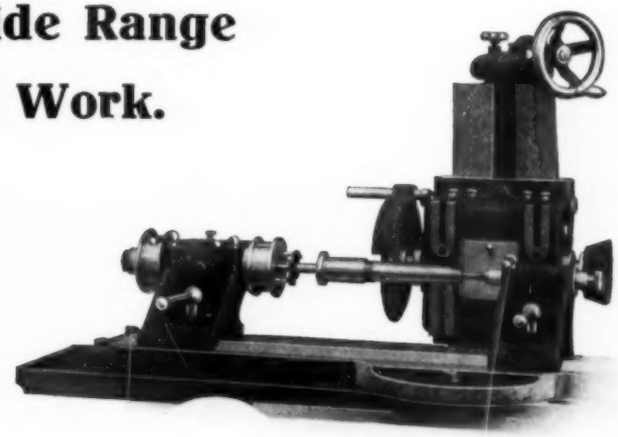
BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.

No. 13 Universal and Tool Grinding Machine.

For a Wide Range of Work.

Circular Grinding.



Cylindrical Grinding.

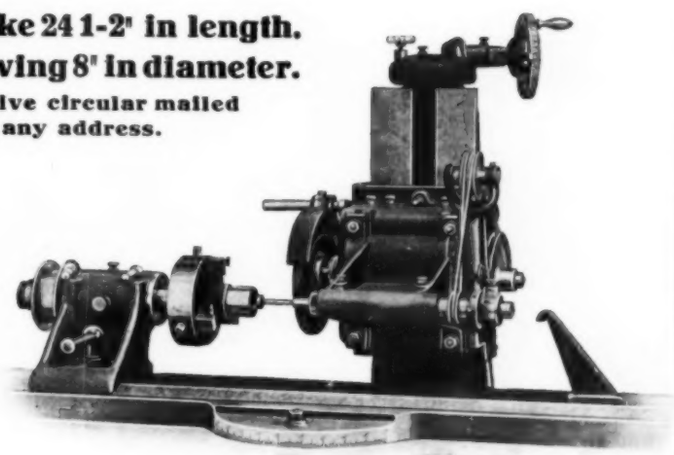
This machine is particularly well adapted to the needs of shops where the volume of work does not require the installation of grinding machines of different kinds but where there is a demand for a machine that will do general jobbing work.

CAPACITY:

Centres take 24 1-2" in length.
Centres swing 8" in diameter.

Descriptive circular mailed to any address.

Surface Grinding.



Internal Grinding.

Fans, Exhaust

Buffalo Forge Co., Buffalo, N. Y.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers

Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps

American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron

Clark Cast Steel Co., Shelton, Ct.
Felton, Sibley & Co., Phila., Pa.

Filing Machines

Cochrane-Bly Co., Rochester, N.Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.
Simplex Mfg. Co., New York.

Flexible Shafts

Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges

Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Page-Storms Drop Forge Co., Springfield, Mass.
Wyman & Gordon Co., Worcester, Mass.

Forgings, Hydraulic

Wyman & Gordon Co., Worcester, Mass.

Forgings, Steel

Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon Co., Worcester, Mass.

Foundry Furnishings

Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers

Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash & Co., Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling

American Gas Furnace Co., New York.

Furnaces, Gas

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash & Co., Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott, J. M., Prov., R. I.

Furnaces, Melting

American Gas Furnace Co., New York.
Nash & Co., Geo., New York.

Furnaces, Oil

Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop

Hart & Cooley Co., New Britain, Conn.
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters

Sturtevant Co., B. F., Hyde Park, Mass.

Gages, Recording

Bristol Co., Waterbury, Conn.

Gages, Standard

Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gear Cutting Machinery

Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker - Brainerd Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Sons & Co., Edwin, Philadelphia, Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut

Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide

Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Norfolk Downs, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas

American Gas Furnace Co., New York.

Gibs

Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Bath Grinder Co., Fitchburg, Mass.
Becker - Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker - Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton & Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfied, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill

Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring

Heald Mach. Co., Worcester, Mass.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Modern Tool Co., Erie, Pa.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding and Polishing Machinery

Abrasive Material Co., Philadelphia, Pa.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Co., Worcester, Mass.

THE U. S. NAVAL GUN FACTORY AT WASHINGTON, D. C.—III

The Various Sizes and Classes of Naval Guns—The North Gun Shop—The Big Gun Lathes

BY H. J. KENNEDY

As our readers know, a cannon, under the present system of construction, is built up by the assembly (by the shrinkage process) of a tube, a jacket, and hoops. The tube forms the foundation of the gun and is in one piece extending the entire length. The greater portion of it is occupied by the rifled bore; in the breech portion is formed the powder chamber. The tube is immediately surrounded by the jacket, which is a sleeve about three-fifths the length of the tube. In the rear end of the jacket is formed the screw box, which receives the breech-block closing the breech of the gun. Outside of the parts mentioned are successively some other shorter pieces known as hoops, that over the forward part of the tube being known as the chase hoop, and those over the jacket being called jacket hoops. Another species of hoop which serves to hold adjacent parts together is called a locking hoop. The 12-inch navy gun is built up of nine sections.

FIG. 16. GUN SHOP, LOOKING SOUTHWARD

It is well to explain here the usage of the Ordnance Department in designating its various designs. The guns are of course principally described by caliber in inches, besides which the total length expressed in number of calibers is usually given. Different guns of the same caliber which possess considerable differences are distinguished by the "mark," written with Roman numerals; and still further, though slighter, differences are expressed by adding a "modification" number. In stating the caliber of a rifled gun, the diameter at the highest points of the lands is meant; if rib-rifled (very wide grooves, very narrow lands), the diameter at the lowest point of the grooves is meant. The depth of the groove of the rifling is about 0.05 inch, and the width of the grooves gradually decreases from breech to muzzle, to compensate for the wearing away of the copper of the rotation band of the projectile as it travels through the bore. The twist increases to about one turn in 25 calibers at the muzzle.

Nowadays the trunnions are usually not part of the gun, but are formed on the

slide through which the gun passes, as shown in Fig. 15 in the previous article. The chase of the gun is the portion diminishing in diameter from the cylinder to the muzzle. The bell muzzle, so familiar to the visitors to the ships of the navy, though adding to the appearance of the gun, is not given for that purpose, but to strengthen the tube at the muzzle on account of the higher terminal pressure produced by smokeless powder. The present design of guns has, indeed, been very strongly influenced by the improvements in powder, as the rate of burning is under better control, the charges are larger, and the gases are given off more gradually than formerly. The natural consequence of all these advances was an increase in the length of guns, so that the projectile might be subject during a longer period in its travel to the accelerating pressure of the gas; also, the strong section of the gun has been carried forward farther, until now we have our guns hooped to the muzzle. For a time the power of the gun increased too rapidly for the projectile, the latter becoming badly shattered upon striking armor of the highest grade; however, the "armor-piercing" projectile now makes available the great power of the gun. (For a discussion of the action of capped projectiles, see the AMERICAN MACHINIST, Vol. 29, Part 2, page 164.)

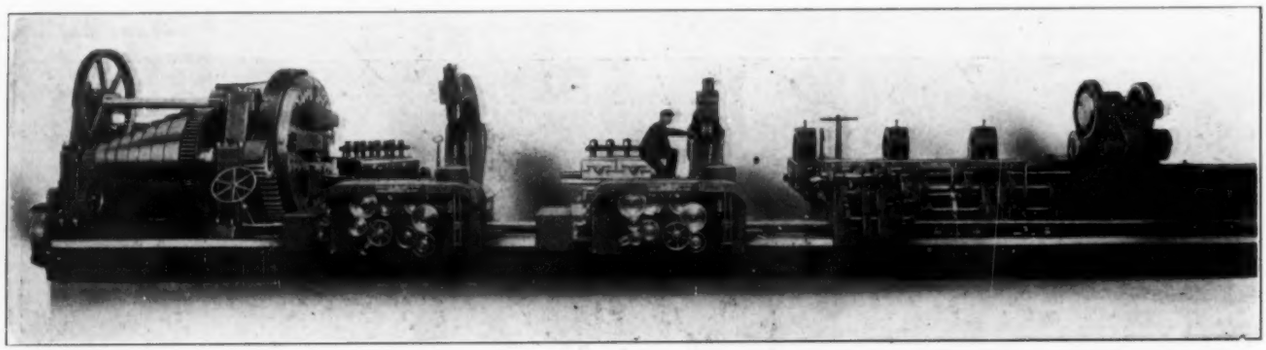


FIG. 17. THE BIG LATHE WHICH CAN TURN AND BORE A 16-INCH GUN (PICTURE TAKEN PREVIOUS TO APPLICATION OF MOTOR DRIVE)

THE SERIOUS EVIL OF EROSION

But the development of ordnance is not even yet plain sailing: the experts are confronted with a serious difficulty—erosion, which gives still another phase to the important question of improving the quality of steel for the construction of guns. In order to keep down the weight of projectiles and thereby minimize the time lost in handling them, as well as the burden on the ship's displacement, increased striking energy has been attained by increasing the velocity, which in turn means larger and more powerful charges of powder, and higher pressures and temperatures of the gases. The repeated firing of the guns under these conditions is being found very injurious to the rifling, wearing it away so that after a certain number of rounds have been fired it is inefficient, the projectiles are not given sufficient rotation, their flight lacks steadiness and there is a loss of accuracy. This necessitates the return of the gun to the shop for the difficult and expensive process of relining. This question of erosion is probably the most difficult problem with which artillerists now have to struggle.

CLASSIFICATION OF NAVAL GUNS

The guns of a ship, excepting field guns and small arms, are divided into main-battery guns and secondary-battery guns, the former being of four-inch caliber and over, the latter, which are intended mainly for defense against torpedo boats, being less than four inches, and including machine guns, which may be of no greater caliber than small arms. The main-battery class (which may be entirely absent from the armament of some small vessels) is subdivided into heavy-caliber and turret guns, which are from eight inches up, the present largest standard size being 12 inches, and intermediate-caliber guns, from 4 inches to 7 inches, both breech-loading rifles and rapid-fire guns.

Diameter of Bore, Inches.	Length.	Approx. Wt. of Gun, Tons.	Approx. Wt. of Mount, Lb.	Wt. of Projectile, Lb.
13	39 ft. 11 in.	63.2	68,825	1130
12	46 ft. 1 in.	52.9	72,128	870
12	41 ft. 1 in.	52.0	63,578	870
10	34 ft. 5 in.	34.6	33,327	510
8	30 ft. 9 in.	18.7	9,305	260
7	26 ft. 11 in.	12.7	26,078 (with shield)	165
6	25 ft.	8.6	18,228 (with shield)	105
6	25 ft.	8.3	18,166 (with shield)	105
5	20 ft. 10 in.	4.8	8,621	60
4	17 ft.	2.9	9,343 (with shield)	33
3	12 ft. 11 in.	1.0	2,826	13

TABLE 1. LENGTHS AND WEIGHTS OF U. S. NAVY GUNS.

The distinction between a "breech-loading rifle" and a "rapid-fire gun" is, in general, that the former uses powder in bags and has gas checks, while the latter uses fixed ammunition and has no gas check. In the smaller guns, the ammunition being so much lighter than in the case of large-caliber guns, its handling does not require much time, and any saving of time attained by more rapid opening and closing of the breech becomes of relatively greater importance, so that even if it require more complicated mechanism to gain this advantage, it may be worth while to use this means of increasing the rate of fire.

In Table 1 are given the lengths of the various naval guns, together with the weights of the guns, their mounts, and the corresponding projectiles.

THE GUN SHOP

The north end of the main gun shop is higher and wider than the remainder. Including the annex, the area of the north gun shop is 31,631 square feet; it is 248 feet 6 inches long and 57 feet 8 inches high at the eaves, and about 45 men are employed in it. In this shop, the exterior of which was shown in Fig. 6, are located the large lathes for turning and boring the biggest guns, from 8-inch to 13-inch or 16-inch if it should be desired, though no gun larger than 13-inch has been built at Washington so far, and it does not at present look as if this size would be exceeded; indeed, the 12-inch is now the standard heavy gun.

THE CRANE EQUIPMENT

There are three overhead electric traveling cranes which traverse the whole length of the gun-shop building. These cranes were built by the Morgan Engineering Company and are of the following capacities: The largest has a main hoist capable of lifting 40 tons, and an auxiliary hoist of 5 tons. Of the next one, the main hoist lifts 25 tons and the auxiliary hoist 2½ tons. The capacity of the smallest is 15 tons for the main hoist and 1½ tons for the auxiliary. In addition to these, the upper or north end of the shop is provided with an additional crane runway at a higher level, which supports a 110-ton Morgan crane (tested to 120 tons), which can run above the other cranes, and which is provided with a 15-ton auxiliary hoist. These runways can be seen in Fig. 16, which is a general view of the gun shop looking southward, and gives a very good view of the group of large gun lathes,

with the exception of the largest lathe, which is nearer to the observer than any of the machines shown in the picture.

SPECIAL MACHINES IN THE NORTH END OF THE SHOP

Before taking up the description of these lathes the machines at the extreme north end of the shop should be mentioned. The first is a horizontal slotting machine (shop-number 200) for cutting the slots in the screw boxes of the guns, these slots separating the different steps of the interrupted thread and allowing the threading tool to clear and to change its adjustment in time for the next radius thread.

in size, is worthy of a somewhat detailed description. Its general arrangement, moreover, is typical of the gun lathes in the shop. This machine, which is shown in Fig. 17, was built by William Sellers & Co., of Philadelphia. It is capable of either turning or boring a gun of 16-inch bore or less, and will turn a gun 57 feet long, or bore one 51 feet long. The total length of the bed of this great machine is 128 feet 3¾ inches, and the length of the lathe over all is 132 feet 9¼ inches. This does not include, however, the electric motor which drives the "quick-shaft" and sets on the floor at the west or headstock

ports the boring bench; this portion is five feet two inches wide, and is also made in two sections bolted and keyed to one another, and to the main bed, the length being 54 feet 5 inches. All the sections are two feet deep. The tool carriages are carried by two ways on one side of the main bed, while the steady rests and tail-stock are carried on two ways on the other side, being provided with clamping bolts passing through a slot. There is no slot in the narrow bed, the boring bench being clamped to it by outside shoes.

THE HEADSTOCK

There are three forged-steel spindles:

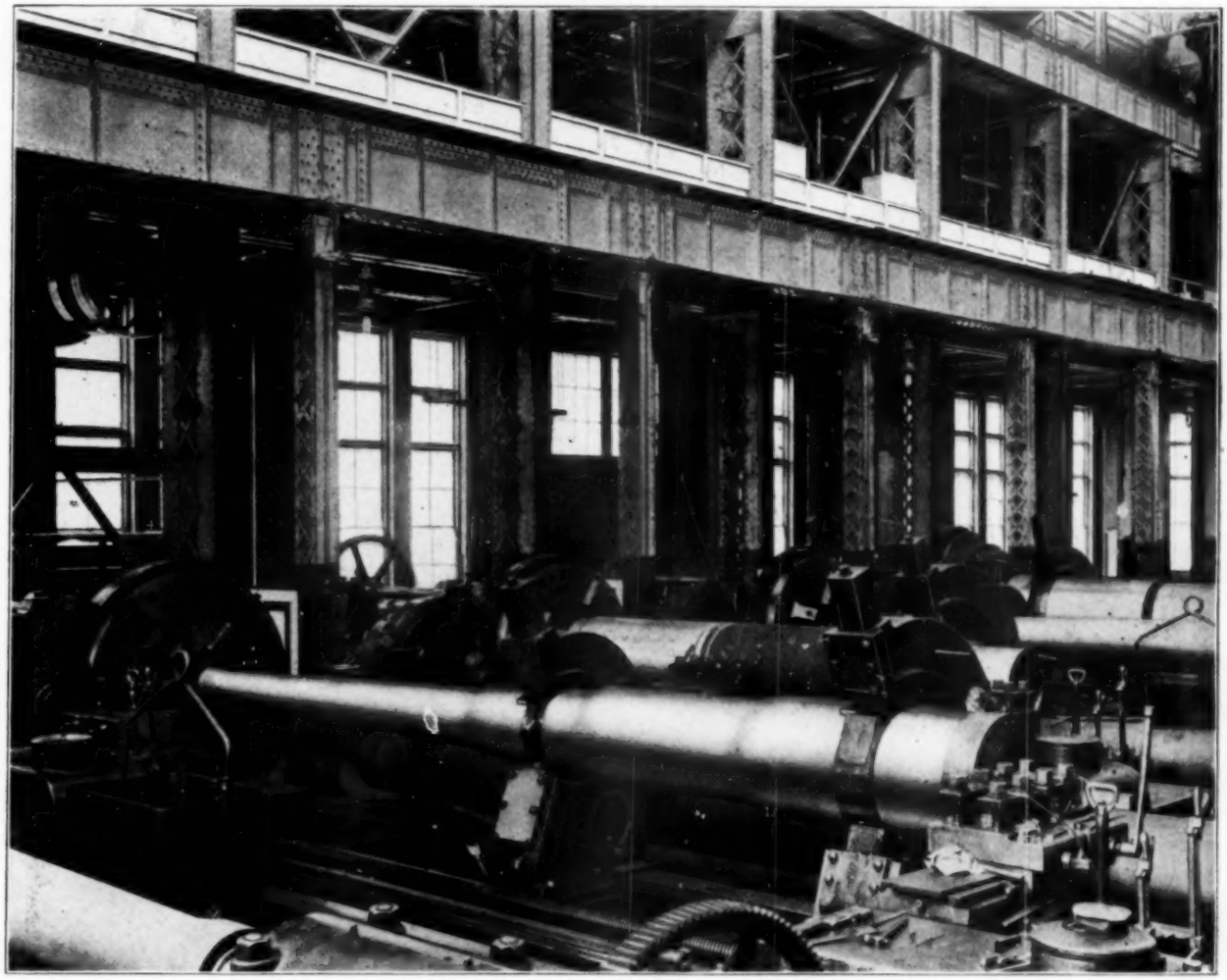


FIG. 18. LATHES NOS. 2 TO 5 IN THE NORTH GUN SHOP

Next south of this machine is a chambering machine (No. 1000), and beyond that is a rifling machine, in which the rifle grooves in the largest guns are cut. Next is a lapping machine for lapping the bores of the guns after they return from the proving ground; both the lapping and the rifling machines will be referred to in detail when the process of gun manufacture is followed through.

THE BIG 16-INCH GUN LATHE

Next we come to the lathe bearing the shop-number 1, which, being the biggest lathe in the place, and really remarkable

end of the lathe, but which, though geared to the latter, is not actually a part of it. The main driving motor is set into the headstock and does not project. The face-plate is 95 inches in diameter, the lathe center is four feet above the surface of the bed, and the swing over the carriage is 70 inches diameter. The principal part of the bed is nine feet wide and is made in two sections bolted and keyed together; the length of this portion, which carries the headstock, tool carriages, and steady rests, is 73 feet 10¾ inches. At its eastern end is a narrower part which sup-

the main spindle, the back-gear spindle, and the face-plate pinion shaft. The former has a front bearing 20 inches in diameter by 32 inches long, and a rear bearing 14 inches in diameter by 24 inches long, these bearings being spaced six feet nine inches center to center. The spindles run in solid bronze bushings. The face plate is carried by the main spindle, and in addition to fitting tight on its nose is secured to a collar on the latter by body-bound bolts. The face plate, which is a steel casting, is provided with four adjustable steel jaws, the ways for these

jaws serving as braces between the exterior and interior rings of the face plate. The face-plate gear has 75 teeth of four inches pitch, 10½ inches face.

THE TOOL CARRIAGES

There are two carriages, the saddles of which slide on the two front ways of the bed, being held down by inside shoes, and guided for a length of nine feet by the front way, on which the thrust of the cut is taken. The cross slide has a slide rest adjustable about a vertical axis, and carrying two tool rests with independent cross adjustment. In order to bring the tool slides as close as possible to the face plate, the axis of the adjustable slide rest is one foot out of center toward the headstock end.

Instead of the usual revolving lead-screw this lathe is provided with a fixed lead-screw of steel six inches in diameter, extending from the headstock to the other end of the wide portion of the bed. To provide for revolving the nut on this screw and traveling the saddle along the bed, there are two square shafts. One is known as the "quick-shaft," and is driven by its own electric motor, and gives to the tool carriage a traverse controlled by hand, of 20 feet per minute. The other square shaft is driven by gears on the headstock. This arrangement permits the operator to ride up and down the lathe on a carriage and to control its motion in either direction, fast or slow, just as if he were riding on a locomotive, independently of what the other carriage may be doing. Of course, with these two big carriages on the ways neither one of them is able to travel the whole length. However, the traverse is sufficient either for work at the face plate or for screw-cutting and facing.

The cross slide also receives its motion from the square feed-shaft in the bed, being fed by a three-inch steel screw. A variety of tapers may be obtained by a combination of the saddle feed and the cross-slide feed, regulating their relative values by the use of change gears.

In screw-cutting the carriage is run back by the quick traverse after each cut, the time for throwing the screw-cutting clutch into gear being shown by an indicator. For turning, all the feeding movements of all the slide rests may be operated by the quick traverse through a friction clutch controlled by the operator, so that he is able to run the tool back to its starting point with a minimum loss of time.

The two square shafts and the long feed screw in the bed are supported at intervals by tumbler bearings provided with caps; a very neat device automatically opens and closes these caps by the action of the tool carriage as it passes by.

Since the steady rests are supported on separate ways from those upon which the carriages run, the latter can be traversed along the bed without any reference to the number or position of steady rests in use, or without any interference with them.

FIG. 19. THE NORTH GUN SHOP, LOOKING NORTH FROM SHRINKING PIT

THE STEADY RESTS

There are four steady rests taking diameters of 61 inches, 54 inches, 40 inches and 27 inches, respectively. The jaws of the steady rest embrace an arc of 220 degrees plus the length in degrees of one block. In order to traverse the steady rests or the tailstock, one of the tool carriages is literally caused to play locomotive, a draw-bar being used to couple the carriage to the steady rest or tailstock as desired, and by this means the latter may be either pushed or pulled to the desired point on the ways.

THE TAILSTOCK

The tailstock is bolted by six 2½-inch steel bolts to the diagonal slot, which is also used to fasten down the steady rests; it has a 14-inch steel spindle and an eight-inch steel center, the spindle being adjustable from the front end of the tailstock. The tailstock can be used as a boring-bar support by removing the spindle and thrust block; and since, as already stated, it is entirely clear of the ways upon which the carriage moves, the latter may be run entirely past it, and may be used to face off the end of a gun, which is thoroughly supported by the tailstock base being close up under it.

THE BORING MECHANISM

The arrangements for boring are very complete. This operation can be performed at the same time that a gun is being turned, provision being made for rotating the boring bar in the opposite direction from that in which the gun is rotating, and at any desired speed, so that the rate of boring is quite independent of that of turning. All the boring mechanism is driven by the square feed and quick-traverse shafts in the main bed, already described.

The boring bench (which is made in two sections) may be moved on the bed by power, acting through a revolving nut on the six-inch steel screw in the main bed, and it may be clamped to the outside of its bed by shoes. In front of the boring bench in the picture is seen a framework carrying its mechanism, which moves along the bed when the bench is moved. For supporting the boring bar there is a capped and bushed fixed rest at the front end of the bench; at its rear end it is held and fed along by a slide; and there are two intermediate supports which travel at proportional rates of speed. At the rear slide there is a 30-inch, 30-tooth gear wheel, which is driven through a friction clutch from the "quick-shaft" in the main bed. The feed of the boring bar is obtained by a five-inch feed screw in the boring bench, which is driven either fast or slow by a train of gears. The range of feeds for boring and screw-cutting is wider than that given to the carriage, since the boring bar has all the feeds of the latter, and moreover each one of them can be divided by ten by means of an extra back gear.

THE OTHER LATHES IN THE NORTH GUN SHOP

Taking the lathes in Fig. 16 in the order in which they appear, starting in the foreground, the first four are of Bement, Miles & Co. build. The first, shop-number 2, has an 88-inch face plate and is capable of turning a 16-inch gun 50 feet long, or boring a 13-inch gun 45 feet long. This machine has a carriage travel of 50 feet, a travel of the boring bar of 50 feet, and will take 55 feet between the centers. The work shown in the lathe is a 12-inch 45-caliber gun, the diameter of barrel being 48½ inches, the diameter at the muzzle 20 inches, and the length of the gun 46 feet 1 inch.

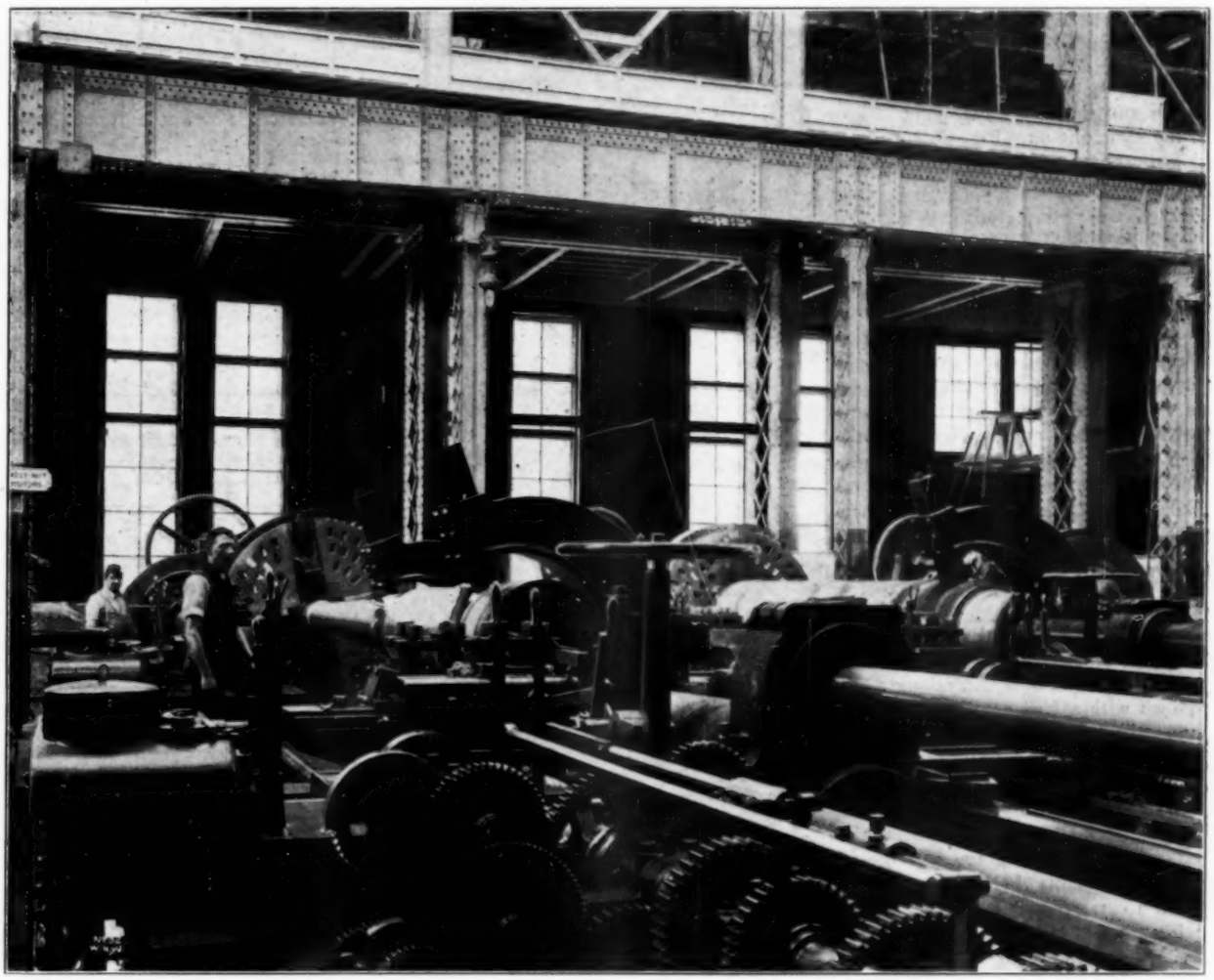


FIG. 20. LATHE NO. 5, FINISHING A 7-INCH GUN

The next lathe, shop-number 3, is the same in size as the preceding one. It is shown chambering a 10-inch gun, the diameter at the breech of which is 42 inches, the diameter at the muzzle 17 inches, and the length 34 feet 5 inches.

The third lathe in the picture, shop-number 4, also has an 88-inch face plate; carriage and bar travels of 30 feet, and is capable of turning a 12-inch gun 37 feet long or boring a 10-inch gun 32 feet long.

In the picture it is shown boring the jacket for a 12-inch gun

The fourth machine, shop-number 5, is similar to No. 4. It is engaged in chambering a 7-inch gun, a nearer view of which is shown in Fig. 20.

The fifth lathe in the picture, shop-number 6, was made by William Sellers & Co., has an 88-inch face plate and can be used for turning guns of 13-inch bore, and smaller, up to 51 feet in length. In the picture it is turning up a 7-inch 45-caliber gun.

The next two lathes, shop-numbers 7 and 8, are Sellers lathes, like the one just mentioned, and the guns in them, which are having their shrinking surfaces turned up, are 12-inch 45-caliber guns.

We have now come to the lower end of the north gun shop, at which point is located the shrinking-pit. Fig. 18 is a view looking northward and shows the four Bement, Miles & Co. lathes, Nos. 2 to 5, inclusive.

Fig. 19 is another general view which gives a very good idea of the north gun shop. In this picture the 110-ton crane can be seen on the upper runways near the far end of the shop. This view was taken from the neighborhood of the shrinking-pit and is looking northward. The first three lathes in the foreground are the Sellers lathes for 13-inch guns. Next beyond these appear the four Bement-Miles lathes, and beyond them in the extreme end of the shop is the big Sellers lathe for 16-inch guns.

Fig. 20 is a near view of lathe No. 5 at work on a 7-inch 45-caliber gun having a breech diameter of 29 inches, muzzle diameter of 11¼ inches, length of 26 feet 3 inches, and diameter of screw box 8¾ inches. One tool is in action taking a cut of ¼ inch with a feed of 0.12 inch. The lathe next beyond this is No. 4.

Each of the gun lathes is driven by its own electric motor, and in some cases an auxiliary motor is also provided for some of the independent motions about the lathe, such as traversing the carriage in making adjustments before starting to work on a cut.

In Fig. 19 will be noticed on each side of the shop an elevated gallery. These galleries, which at the upper end of the shop are on a level with Dahlgren avenue, are used for doing work on the gun-sights and some similar small work. The machinery in the gallery is driven by two 25-horse-power motors, one on each side.

In the next article the building up of a gun will be followed through step by step, commencing with the receipt of the forgings at the gun factory.

At the mines of the Compania Minera Borda Antigua y Anexas, near Tlalpujahua, Mexico, a 150-horse-power Westinghouse a.c. hoist motor is being applied to a standard Lidgerwood steam hoist; centrifugal pumps and blowers will be driven by a.c. motors.

MOLDING A TOGGLE PRESS BODY IN GREEN SAND

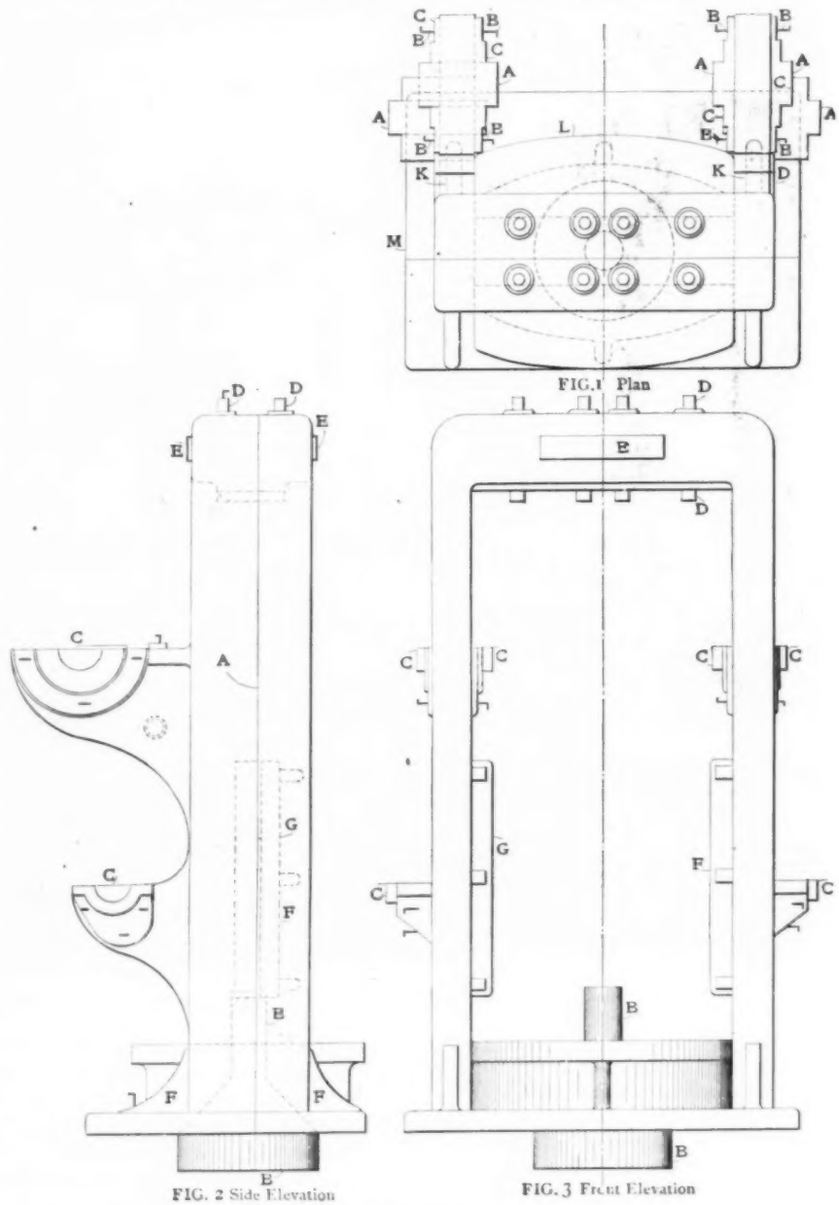
A Casting Requiring 30,000 Pounds of Iron to Pour It—How the Pit wa Rigged Up—Careful Provisions for Venting

BY R. H. PALMER

The casting to be made is 10 feet 8 inches high by 6 feet wide, and the pattern is shown in Figs. 1, 2 and 3. *A*, Fig. 2, is the line on which the pattern is split to allow the lower half to be molded by bedding in the floor, and the upper half to be molded in the cope. *B*, Fig. 2, is the print of the main core, *D* prints of bolt cores, and bosses; the parts of the pattern to be drawn inward after the main part of the pattern are shown at *C C*, loose bracket at *F*, and prints for name-plate cores at *E*.

Fig. 3 shows the front of the pattern; the view of the casting would be the same minus the prints *B, C, D,* and *E*. In this view are best shown the crosshead guides *G*, which are seen dotted in at *G, F*, Fig. 2.

Fig. 1 shows the end view of pattern or plan, with bolt-hole cores, Fig. 2, *D*. In this view are seen the different loose



THE PATTERN

parts pinned on as *A* and *C*, held on to pattern by pins *B*, while *L* and *M* are the flanges lettered as in Fig. 4, and *K* are the brackets.

THE ARRANGEMENT OF THE PIT

Castings of many shapes are molded in this pit and the arrangement of binders is such as will accommodate a great variety of work. These are easily seen at *A*, Fig. 5, covered with the heavy plates *B*, also heavy posts of timber extending from the binders up to the joint on which the cope (weighing seven tons without any sand in it) is to rest, and when the cope is bolted down, serving to keep the heavy cope from being drawn down too far and crushing the mold. The heavy eyebolts *C* are shown and the manner of securing at the bottom. They are riveted

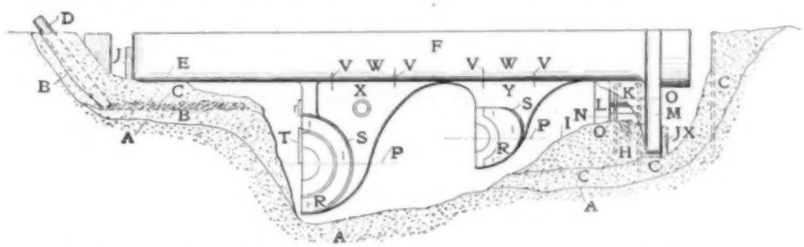


FIG. 4. LONGITUDINAL SECTION SHOWING PATTERN WEDGED IN PIT

over after passing through the binders, washers, and nuts so that they will not turn; the eyes into which the other bolts are to hook are at the joint; we will refer to them later.

The pit is dug to the depth of line *A*, Fig. 4, or a little deeper, and sand rammed in to line *B*, and on this line a bed of cinders *C* is rammed solidly down and gas pipe *D* arranged, and the sand is rammed solidly over them, the cinders being first covered with paper to keep the sand from getting in among them, and thus partly closing up the cinder bed.

The sand is rammed up to within about one inch of the line *E*, and is then given a good venting down through the sand and paper into the cinders; then the bed *E*, on which the pattern is to rest, is made. There are many different ways of making such a bed as *E;* some molders making it up by the use of straight-edges, using one to pound the sand down, but in this case the bed was made up by hand, as it is termed, and needle-wired down to the larger vents. Thus the gases travel through the smaller vents to the larger, to the cinder bed, and up the pipe to the outside of mold.

The heavier the mass of iron to rest on the bed the longer the iron will remain in a fluid state; thus it will be seen that if the gases do not escape fast enough by the means provided they will find their way into the mold, and cause a boiling and working of the metal in the mold, producing scabbing and dirt.

MOLDING THE NOWEL

The pattern is now placed in the pit with one end resting on the bed *E*, shown in Fig. 4, and the other end held up by wedges *H*, thus keeping the pattern level. Facing sand is used next the pattern, and sand is rammed solidly under the pattern and up to line *I*, Fig. 4. As fast as possible the wedges *H*, holding up the pattern, are removed, and sand rammed in their places.

Stakes *J*, Fig. 4, are then driven, and the pattern removed. These stakes are needed to guide the pattern back to its place after having been taken out.

A channel-way is cut at *N*, Fig. 4, and a good venting is given at the pattern down around the flange, and then the channel-way filled with cinders rammed in, and covered with paper. Pieces of board are held against the sides of this core, at *Z*, and rods of iron are driven into it as

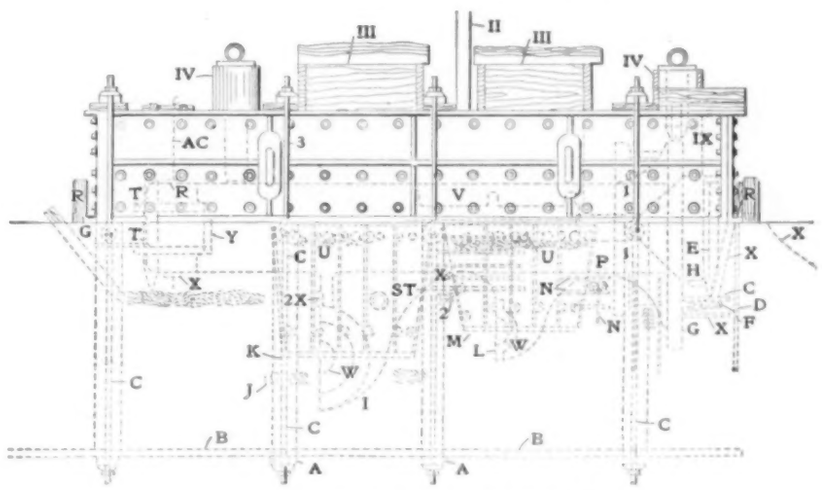


FIG. 5. ELEVATION OF COMPLETE MOLD

shown at *O*, to support the green-sand core formed between the two flanges.

The pattern now has the loose brackets *K* removed and is replaced. Facing sand is placed next the pattern, and black sand to back it up, and the sand is rammed in between the two flanges. The pattern is then removed, and the face of the green-sand core is carefully felt over, finished, and nailed over; the heads of nails being left even with the face of mold, and when venting care being taken that the vents extend down through the paper into the cinders. In finishing this part of the mold it must be carefully felt over as later it will be hard to get at it.

The pattern is now put back for the last time, and stakes *J* are drawn out. The brackets *K* are replaced, and as the sand is rammed around them the pins are drawn out. When the sand is rammed up at the back of the pattern as high as the top of stake *J X*, now shown as in the sand, a cinder bed is put in to carry off the gases from that part of the mold better seen at *X*, Fig. 5.

The channel-way containing cinders *N*, Fig. 4, is extended to carry the vent to beyond the outside of cope when closed on, and the pipe put in to bring the vent to the surface, Fig. 5.

The pattern is faced, and the sand is rammed firmly around it as high as lines *P*, Fig. 4, on the outside along the center; but the two ends are rammed up to near the joint. At this point the mold is given a good venting, and the vents covered with cinders, and led out to beyond the cope, and sand rammed up to the joint; pins being removed from the loose pieces as they are met, and the sand rammed in, and under the main print *E*, Fig. 5, a plate is rammed in to help hold up the core and strengthen the mold.

In ramming up around the jaws *I*, Fig. 5, some cinder beds *J* and *O* are put in, and the vent brought from them to connect with the other vents. At *T*, Fig. 4, a piece of board is tacked on to the two jaws to keep them apart the right distance,

When ramming around the jaws the sand must be firmly rammed; remember the amount of head there is, and the consequent strain on all parts of the mold, as the jaws extend down in the floor about 44 inches, and the hight from the joint to flow-off is 30 inches. When ramming up the walls of the mold some rods as *G*, Fig. 5, are rammed in with the sand, pointing toward the casting, thus strengthening the mold.

The inside of the pattern is rammed up, and near the top the sides are given a good venting, and vents covered with cinders, and channel-ways led to the center of the joint, the cinders covered with paper, and the sand rammed firmly

around the pattern, and down on the cinders.

At the proper time and place the pouring gate cores are placed; they may be seen dotted in Fig. 6, with upright gate-sticks *H*, and in the center at *B* is seen where the gas is to escape from the center through the cope when arangements are completed.

A joint is made at *P*, Fig. 4, and *K* and *M*, Fig. 5, also a joint at the side of jaws at *P*, Fig. 1; this joint is made almost straight up and down on each side of the jaws. Any molder knows how hard it is to get a good lift on an almost straight joint of this kind, so the face of the parting is covered with oiled paper held on to the joint by pushing nails through the paper, paper being found an excellent parting medium.

The iron box which is to lift the sand from over the loose pieces is rapped down to a bearing on joint *P*, and taken up to see that it has done so.

Referring again to Fig. 6, *D D* show two of these iron boxes covering the loose pieces *E;* the sand is rammed in around the one to the left to the hight of *M*, Fig. 5, then the joint is made for the one to the right, and sand is rammed around both, and the cinder bed put in at *Q*, parting is made at *S T*, and they are rammed around outside up to the joint, or parting of mold.

The inside of the boxes is rammed up as we would ram a flask. When near the joint they are well vented, and pockets of cinders are placed as shown by *U*, Fig. 5, covering these vents, and are brought to the holes in the back of the boxes. It will be seen that the box to the right has an overhang to it that covers the parting *S T*, and this overhang is carried by rods overhanging from this box pushed into holes in the base.

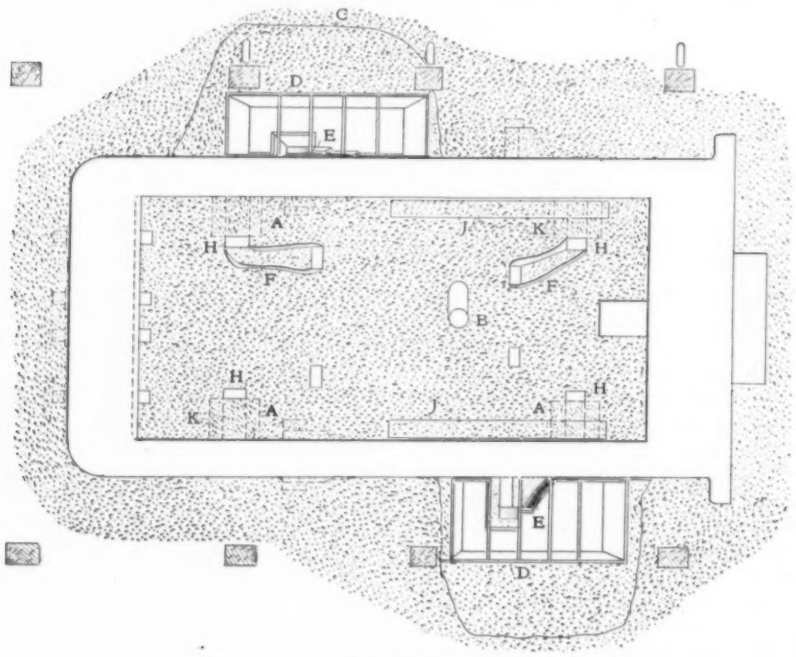


FIG. 6. PLAN OF PIT

MAKING THE JOINT—THE COPE

The joint is then made; and when it is made in the center the cope half of pattern is placed on the lower half, and the sand is tucked up under the guides *J*, Fig. 4, and *V*, Fig. 5, changing the shape of parting some as the guides are above the center and joint of pattern.

The cope is hoisted up, and lowered gently over the pattern, being guided to its proper place, staked, as *R*, Fig. 5, removed, and the joint covered with facing sand for setting the gaggers, and replaced.

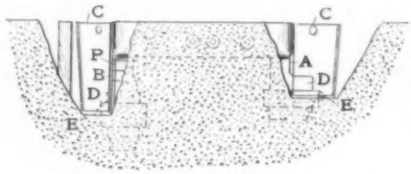


FIG. 7. TRANSVERSE SECTION OF PIT

Often one will have a cope where there are more chucks needed, and at times it is hard work to secure them by wedging, or find any way to secure them. In this case we found it to be so; chucks were therefore cast having a lip on the side at the top so that they would hang on the side of a bar, or hang between bars on two extensions beyond the sides, and the sand rammed around them same as any bar in the cope; they do the work very acceptably.

Pouring gates and risers are set, also gate-sticks, where vent is to escape, and flow-offs. Gaggers are set, and the cope is rammed up, vented, and hoisted off, rolled over, joint made, pattern drawn, and finished.

Name-plate core is hung in the cope at *R*, Fig 5, with wires *A C* fastened by a rod pushed through the wiring and wedged up (see top of *A C*), then nailed around the core, leaving the nails with heads flush with face of casting, and given a good coat of blacking ("silver lead"), then rolled over. The joint of the pattern in the floor is brushed off, and screws holding the main part of the pattern on to the jaws, as in Fig. 4, *W* to *Y*, and *W* to *X*, are taken out, and the pattern is drawn, and then each jaw separately.

DRAWING HEAVY PATTERNS

In heavy patterns of this kind, if there is only one to be made, do not try to draw with screws. Have straps of heavy iron put on with a toe turned under the pattern, and the hole for the hook in the other end so you can pull pattern out, then stop off the places in the mold where the straps left their impression.

Some of the sand at the back of the box, left-hand side of Fig. 5, is taken out part way down, and this box is hoisted out, then the one to the right is hoisted out, both sides, of course, being treated alike.

These boxes are hitched into, in the holes through which vent is to lead out in the back, and holes provided in the sides, seen in Fig. 7, being reached by removing some of the sand. They are then laid on their backs and finished as other parts of the mold, and the face nailed.

As the parts of the pattern at the jaws are so deep there must be some way provided to reach the bottom of these jaws, and set the cores, also to draw the pieces, *A A*, Fig 3, on the inside of the pattern, and finish, nail and black with any degree of certainty.

SETTING CORES

The mold being finished, the core which was covered by the right-hand box, Fig. 5, is pushed into the print on the opposite side of jaw, and dropped into the print *W;* the box covering it is then replaced, then the core covered by the right-hand box is served the same way, and the left-hand box is replaced, and sand at the back of the boxes is rammed in again, but channel-ways filled with cinders are extended out beyond the joint of flask for the vent to escape from these boxes, seen at *B*, Fig. 8.

The core 2 *X*, Fig. 5, is also set, nailed around, and held in its place by spikes in addition to its print.

While finishing the mold the name-plate core is bedded in at *Z*, and nailed around, and spiked down.

Cores *T*, Fig. 5, are pushed into prints at *T*, the other end dropped into prints *Y*, and stopped over. The main core, *E*, Fig. 5, is set, and sand rammed in at the back of it.

Flour is run over the cores, where the cope is to bear on them, and parting sand is strewn on the joint. Chaplet 1 *X*, Fig. 5, is put in the cope, and the cope is tried on, the flour and sand showing how the

cope bears on the joint and cores; flour is also dropped down the pouring-gate holes. The cope is then hoisted off.

From where the flour fell through the pouring-gate holes to the down gate in the floor, a channel-way is cut as at *F*, Fig. 6, allowing the iron to flow down through the cope from the runner through this channel-way to the down gate in the drag or floor, and enter the gate through the gate cores, passing into mold.

The bearing on cores and joint being found to be correct, the joint is pasted, and on some parts, as next the flanges, a soft clay worm, or roll of clay, is placed so it will squeeze when the cope bears on it and insure a good bearing, yet do no damage. The large core *E*, Fig. 5, has a clay worm laid on the small end, and the larger is pasted on end. Chaplets are passed up through the cope to hold this

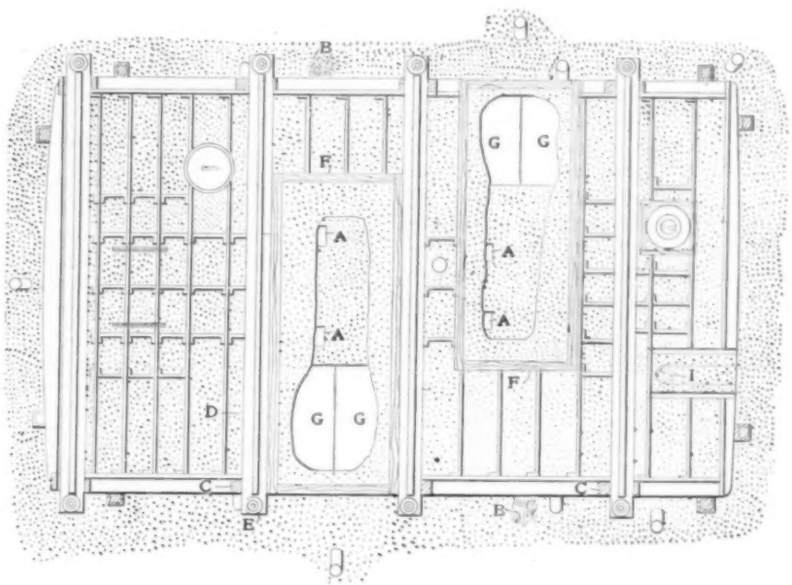


FIG. 8. PLAN OF COMPLETED MOLD

core down. Gate-sticks are placed in the gates, and pipe *I I*, Fig. 5, is placed in the gate hole in cope.

CLOSING THE MOLD

The cope is now closed on. Pieces of iron or hard wood are laid on the top of cope, seen at *C*, Fig. 8, and across these the binders are laid as at *D*. Bolts 3, Fig. 5, are hooked into those in the floor *C*, Fig. 5, and placed in slots in the binders; washers are put on the bolts covering the ends of binders, and the nuts are tightened down solid.

Runner boxes are placed on the cope, and runners built with cores placed in the bottom of basins, as seen at *G G*, Fig. 8, to keep the iron from cutting the bottom of basin as it drops into it. Gates down which iron is to flow are seen at *A A*.

Risers and flow-offs are built, and covered. The chaplets which hold down the main core come up under ledges cast on the sides of proper bars so the fastening of the chaplets is simply slipping a wedge over each.

The bar at the end of cope, at the end of the large core, was not rammed up when the cope was rammed, but is left and rammed after the cope is closed on for good, and provision is made for the escape of gas from this core, and that the iron shall not get into the vent.

The different escapes for the gases are now uncovered, and plugs taken from pipes; when the pipes are put in, they are always plugged so that nothing will accidentally get into them.

The runner boxes are weighted, as shown in Fig. 5, so that they will be held down, and the whole method of securing the mold together gone carefully over to be sure everything is secure.

When molding, the gate cores were set to have the iron enter the mold at as low a point as it could without being too low; as soon as the iron reaches a certain point it will be iron entering iron, cushioning, as we term it.

The nailing of the face of the mold and leaving the nail heads flush with the outside is done to secure the face from cutting, where there is such a heavy body of iron in so small a space, or, in other words, such a compact body.

The covering of the risers is so that the face of the mold will not be drawn down, as it takes some time for the mold to fill.

POURING

When the mold was poured care was taken that the vents were all fired as fast as they would ignite. After pouring, the hot iron in the mold kept alive long enough to require 14 hand ladles of iron to be fed into it as it was pumped.

When ramming up the pattern in the floor at the large end or back of large part of core *E*, Fig. 5, there is a plate of iron rammed up in the sand to help hold the pushing strain; see *D*, Fig. 5.

I have called attention to the venting a number of times in this article. When a mold is so constructed that the gas escapes easily one can see it poured, and feel reasonably sure that there is little danger of its scabbing; but when the gas escapes slowly, and little escapes, trouble may be expected pretty surely.

The cope was left on until the next day, and when the casting was taken out, was found satisfactory.

Sammy's Shop—Help Wanted—Difficulty in Getting a Good Boy

In the old days, when he was working for someone else, it had often seemed to Sammy that the work would go much better if he had received a little more encouragement and had been made to feel that he was a necessary part of the works.

THE HAPPY PROPRIETOR

Having now acquired a shop, he was owner. He thought of it with a feeling of exultation. He could do as he pleased. His future was in his own hands, and with time he might be able to build up a business that would rival some of those that he had known so long from always seeing their advertisements in the AMERICAN MACHINIST. Yes, he walked on air. Don't smile. We all see things strangely before that expert optician, Experience, gets us fitted with proper mental glasses.

As he started in to straighten things up so as to be able to get down to steady running, he thought over his future and made more resolutions for his own guidance than he had ever done on any New Year's day.

A FEW GOOD RESOLUTIONS

Among other things he determined that every job that left his shop should be first class, that the price should be right, that everybody should be treated with courtesy, that he would pay for everything promptly, that the treatment accorded to every one who might work for him should be such that they would never voluntarily leave, that all promises made as to when a job would be done should be kept, that a customer could be sure of having all his instructions as to material used carried out, and a whole lot more that were to help make that dingy little shop a much to be desired oasis in the mechanical desert.

WORK COMES IN AND A BOY IS WANTED

Mr. Davis (by the way, that was the name of the man who sold the shop to Sammy and so started him on the road to fame, distinction and wealth) promptly sent in a lot of work, and induced some others to come in and meet Sammy. A number of them promised to give him a trial.

Even when treading on air and working

for one's self it is not possible for a man to so stretch his capacity as to cover everything, and Sammy soon decided that he needed a boy to look after the boiler and keep the shop in order. Boys were plenty and he soon had one engaged at $3 a week. He was about 16 years old and nearly as large as the youthful proprietor, and hadn't a doubt as to his ability to do everything that was mentioned as being in his line.

SOME SIMPLE INSTRUCTIONS

"You must he here in time to get up steam and have the engine going by seven o'clock." The boy nodded assent. "And keep the shop so nice that you would not be ashamed to have the President of the United States come in." Again the boy nodded. "The way to get more money is to attend to business, and make yourself worth it." This last remark seemed to strike a responsive chord for the boy replied, "I want to git all I can git."

Sammy wanted that boy to be happy with him but he also wanted him to be of use. He disliked anything that looked like nagging, but found that he had to do a lot of telling to have things done.

AN "ORDINARY" BOY

The boy was just an ordinary boy. He was not particularly good, but neither was he particularly bad; but he *would* forget to look after the fire, until the steam pressure fell so low that the engine would begin to slow down; he *would* forget and flood the boiler with water; he *would* forget to clean the flues, until they were so clogged that they had to be cleaned in the middle of the day; he *would* go on an errand and almost forget to come back; he *would* find new places to put things, forgetting where he had been told to put them and forgetting where he had put them; he *would* get saucy to a customer who happened to speak sharply to him.

OTHER THINGS HE WOULD DO

And he *would* get so interested in watching a rat dodging around that he would forget time and work; he *would* have to be told each day to do the things that he was supposed to do without telling, and he *would* take a lively interest in trivial things that were of no importance to the shop, very unlike the faint sparks of interest that Sammy was able to make him show about the work in the shop, until Sammy's patience was strained away beyond the elastic limit. He began to think that it cost more to have a boy do anything except to fire the boiler and sweep the shop than it did for him to do it himself; and evidently the boy began to think that he had got onto the wrong road in seeking his fortune, for he quit and went to carrying water for a gang of men who were grading for a railroad.

A SERIOUS PROBLEM

For a time there was a variety of boys, good, bad and indifferent—mostly the latter, from Sammy's point of view—until the boy question got to be a sort of nightmare.

One day when he was so busy that he did not know which way to turn first, and when some of his resolutions were strained if not entirely broken, he had just eliminated a particularly aggravating specimen, when another one came in. As soon as he got inside he took off his coat, and throwing it on the bench came straight for Sammy. "I am all ready for business," said he. "What-all do you want me to do?"

This was not just the boy that Sammy would have picked out of a crowd, but still he had an air as though he had taken posession.

"How do you know that I want you at all?" he asked.

A SHREWD YOUNGSTER

"I've had my eye on this shop for some time. I came in one day to see when you would want me, you mind, and you said that you wasn't ready to take a boy like me on yet; and then I was in one day when you were out, and this last boy told me that there wasn't any chance as long as he was here, but that he didn't think he would stay very long and I could have the place as soon as he got through with it. I have been keeping my eye on it since that and was outside when he came out. He told me he didn't intend to help you out any more, so I will. You don't need to pay me anything for today, as it will take some of your time showing me what to do and I will have to learn things too."

THE PROPRIETOR SURPRISED

This last was too much for Sammy. He meekly led the way to the boiler, and, after making sure that the workings of it were understood, and finding out that his new possession answered to the name of Albert, he returned to his work with a confused idea of not knowing "where he was at."

Looking around some time afterward he saw Albert busily at work cleaning off the bench. On going down to the boiler, he was surprised to find the coal all scraped back into one corner and the floor brushed up. He had never had a boy do that before without being told, and then it had been once telling once done, and even then seldom well done.

ANOTHER ASSISTANT

The next morning he got around early and he had another surprise. Albert was cleaning the flues and an elderly man was watching him. "This is my father," said he, with a nod of the head. "He has worked around boilers and engines all his life and knows all about them."

"He told me the other boy had not left things in very good shape, so I thought I would just drop around and see that he got started right. He knows a good many things about a boiler himself, but he never had charge of one before. I don't work very far off." Sammy had begun to wonder if the father had attached himself to the place, too; but the father walked away as he finished speaking.

THE NEW BOY'S PECULIARITIES

Albert was a puzzle to Sammy. He seemed to take naturally to the shop work, and it was not long before he was threading bolts, and drilling, and even doing plain jobs of planer and lathe work, and still he did not seem to be nearly as intelligent naturally as some of the other boys. It was hard to tell him in words, but a little showing was all that was needed. He was slow-moving to look at, but he really seemed to like to work, and his moves counted.

To get out the work it was often necessary to run the shop in the evenings, and sometimes Albert's father would drop in. While he was not an educated man, Sammy found that he was well informed about machinery and repairs on it. He invited Sammy to come over to his place some evening when the shop was not running.

SAMMY MAKES AN EVENING CALL

One evening Sammy went and was taken to the little shop where the man spent most of his spare time, and where Albert had played with the tools as playthings. The foot lathe told how he had so readily known how to set a tool to have it cut. He had been free to play here, but the father had insisted on things being kept orderly. Every tool had its place and must be found there when not in use. The interest and talk of the father was in and about the machinery in his charge, and Albert's mind had fed on it, and the importance of its being kept in proper order admitted of no contradiction. He had even lent a hand when something had to be taken apart and adjusted or repaired on his father's job, so that while it was play to him it was playing with real things that did real work.

THE UNEDUCATED MECHANIC

Sammy began to understand how it was that a boy who wrote a miserable hand and was thick-headed with figures could work all around other boys who were fairly well educated. His grandfather and his father had worked with machinery and loved it. He had found in it something tangible; something that he could handle and see and follow the workings of. Some of the other things of education were only seen in the head, and he lacked imagination and saw them faintly, if at all. Doing a sum meant nothing to him; but patching a piece of machinery so that it might again take its place and do useful work, meant doing something that was of the utmost importance.

Albert did not seem to have any ambition outside of his work. He was not a reader or a student of books. He was ingenious and persistent in anything in which he was interested, but that thing had to be something that he could see and handle.

EXPERIENCE WITH APPRENTICES

It may be as well to say that Sammy is

not the only one who has been disappointed in the results obtained from intelligent boys of good education in the shops.

A friend once told me that he had decided that he would not take into his shop to learn the trade of machinist any boy who had not the equivalent of a high-school education. The boys he needed were to supply his need for good operatives. He was not training expert salesmen or mechanical engineers. A few years after that he told me that he had concluded that neither education nor seeming general intelligence told much about a man's ability to get good work, and lots of it, out of a machine.

Sammy partly learned that from his experience with the various boys, and later experience with men has only burned it in.

W. OSBORNE.

THE SAW-TOOTH ROOF IN FACTORY-ROOF CONSTRUCTION—II

Continuing the abstract ot the discussion of the A. S. M. E. papers by Messrs. Hinds and Richmond, S. H. Green said:

Mr. Hinds has not brought out in sufficient relief to be of use to one first attacking the problem, the troubles pertaining to saw-tooth skylights. I shall attempt to show in the following what these troubles are, to point out some of the faults of Mr. Hinds' design, and to describe what I consider the best methods and details of design to meet these troubles.

In all my remarks I refer only to the saw-tooth roof as used in the textile industries, as the requirements in this field are far more exacting than in any other.

The excellent lighting qualities of the saw-tooth skylight are well known to those who have had experience with it, but the person who has never been in a building properly lighted by this method has a surprise in store, as north light has a very penetrating power, and under it imperfections of surface or texture are readily discerned.

The advantages of the saw-tooth form of skylight lighting over the ordinary skylight depend entirely upon the requirements of each case. If it is desired to obtain north light or to exclude the direct rays of the sun, or if, as usually happens, both requirements exist together, there the saw-tooth is the only solution of the problem. But if these requirements do not exist then I think the skylight of the ordinary form is preferable.

TROUBLES DUE TO WINTER WEATHER

Practically all the troubles of the saw-tooth skyligh are caused by the severe winter-weather conditions of our northern climate, and can be classed under two heads: leaks caused by severe outside conditions, and inside condensation caused by low outside temperatures. Rain, of course, will find any ordinary hole or crevice. Snow and ice cause water to back up and find imperfections that otherwise would not cause trouble. Snow and ice will freeze on to the roof and cause the roofing material to pull and sag. Frost will get under nail heads and pull the nails out.

Recently, in connection with my work for a prominent woolen company in Massachusetts, I was called upon to design a weave-shed for 900 looms. This concern already had in operation a large shed, which I am informed was the first saw-tooth weave-shed built in this country. It was of the English type and possessed all its faults, except as they had been partly cured by the mill management.

The first move I made was to see what other mill engineers and architects had done. During severe winter weather I investigated some of the more recent sheds belonging to the most prominent textile concerns in the North, and I must say I found that very little progress had been made to get at the real cause of the many difficulties and annoyances from the saw-tooth construction. Evidently architects had not had practical experience in the maintenance of their designs, and had not benefited by their failures. I was, however, connected with a superintendent who had for years carefully noted the troubles and had made strenuous efforts to overcome them, and it was largely due to his suggestions that I was enabled to design a roof that I believe practically meets all the difficulties.

I will take up Mr. Hinds' paper in paragraphs. It is not correct to say that the principle of the saw-tooth skylight is to focus the light. On the contrary, the best results are obtained by the use of factory-ribbed glass, which diffuses the light, giving all parts of the room equal strength of light. The amount obtained is, of course, a function of the glass area and the floor space of the room to be lighted.

The concern previously referred to, built as early as 1880 what Mr. Hinds calls

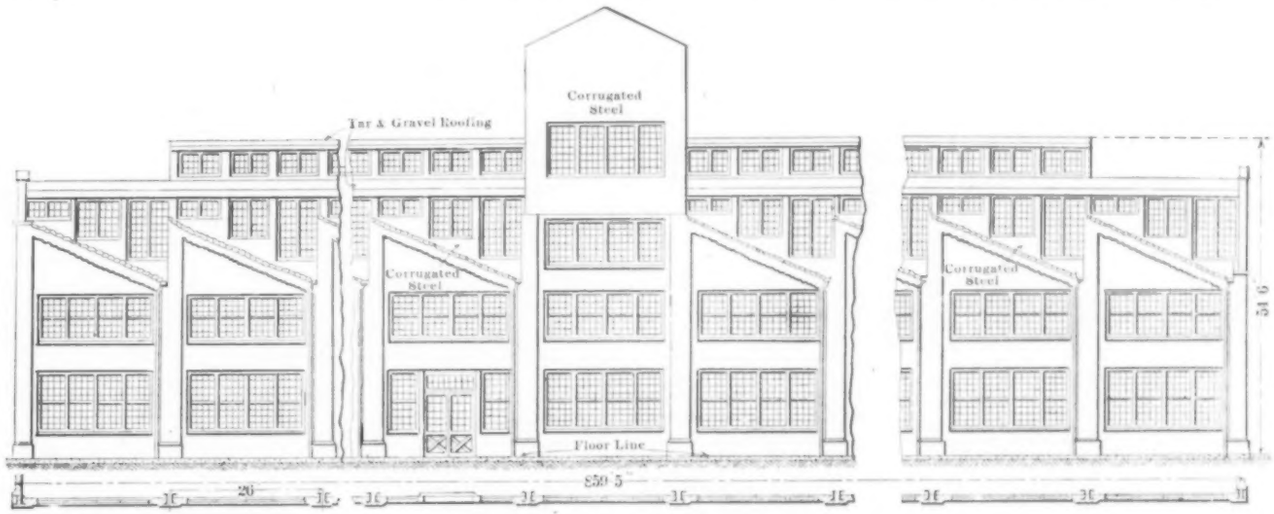


FIG. 10. WEST ELEVATION LOCOMOTIVE SHOPS

the Americanized type, which consists, as I understand it, of a flat gutter instead of a rounding one.

To explain more fully the troubles of the metal gutter, the test of the English type of gutter, and in fact of any other design, is winter weather. Changing temperatures cause the metal to expand and contract until it breaks and then leaks. The worst condition with snow is when it melts, then freezes, and then melts again under the ice, thus causing the water to back up hill, as it were. This water will discover any aperture at cap flashing on the glass side, or between the metal gutter and roofing material, on the other side.

THE SHARP GUTTER

In our northern climate the sharp gutter

was found impossible at once by all the first users of it, and the change to a flat gutter roofed with the regular roofing material was made simultaneously by several companies.

The company mentioned, as early as 1880, built an addition, using the wide flat gutter. The old roofs that they first had were covered with slate on the flat side. This they removed and replaced at various times with many kinds of prepared roofing material, all of which failed.

Too much pitch to the gutter is not possible. One-half inch per foot is none too much, but usually is all that can be reasonably obtained. It is a mistake to try to carry all the water to the end of the skylight or gutter. It is better to put in an ample number of down-takes for the roof water, at intervals along the length, carrying them down inside the building.

THE ANGLE OF THE GLASS

A 60-degree angle of glass I have found highly satisfactory in the North. I have never experienced any trouble from the direct rays of sunlight, especially if factory-ribbed glass is used. In this connection, the angle at the ridge of the roof should be 90 degrees or more, in order that the light may not be thrown against the inside of the roof. I would not hesitate to make the angle of the glass 55 degrees, and that of the ridge 95 degrees.

The elimination of all cross beams that cast shadows is a necessity in textile work and can always be done by using sufficient posts, if the requirements will allow. The use of a rod for the lower member of the truss, in place of a beam, is a good idea, although this beam does not interfere with the light as much as a beam running parallel with the roof.

In the north, double glazing, on account of its better heat non-conducting qualities, is preferable to the single. The only serious objection is the difficulty of repair.

CONDENSATION

These paragraphs refer to the greatest weaknesses of the design described by Mr. Hinds. He passes lightly over the problem of condensation. In textile work a high degree of humidity is maintained, with the result that in cold weather condensation on the glass is very great. This is especially objectionable in a weave-shed, for the reason that even a drop of water on a sized warp will cause exceedingly bad work. The objection to Mr. Hinds' method of taking care of this condensation is that the holes he provides for letting this water outside will collect an icicle and freeze, with the result that the gutter fills and runs over into the room. These holes also allow a large amount of cold air to leak into the room. The proper method is to remove this water by means of inside gutters.

To determine the value of one of the much advertised forms of metal-bar sky-

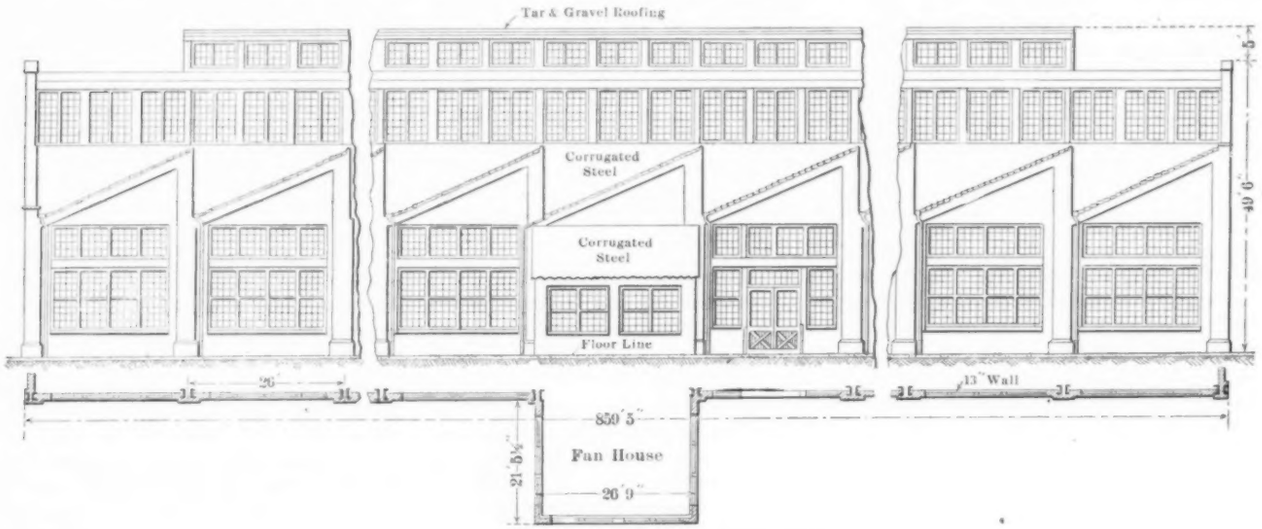


FIG. 11. EAST ELEVATION LOCOMOTIVE SHOPS

FIG. 12. END ELEVATION LOCOMOTIVE SHOP

lights for saw-tooth work, I installed a small section, with the result that the lower ends of the bars, on the inside, were covered with very heavy frost, and the aperture to allow the water of condensation to escape froze up. Of course, these faults barred the design from consideration.

METAL VERSUS WOOD

The principal advantage of metal construction over wood is the ease of installation. Its disadvantages follow: Metal is a better conductor of heat, and therefore causes condensation. Particularly the upper and lower horizontal members of the metal skylight, on account of coming in contact with both the outside and the inside air, are a very great source of annoyance, through becoming condensers.

The horizontal members are long and therefore badly affected by expansion and contraction, and it is difficult to make a satisfactory joint between the lower horizontal member of the skylight and the gutter construction. Mr. Hinds' method is entirely inadequate, as water, in the event of snow filling the gutter, will certainly back up through any counter and bottom metal flashed joint that can be made.

THE SLAT WALK

The slat walk must have a bad wearing effect on the roofing, and in a way defeat its purpose, in that it holds the snow and ice and prevents its rapid melting. The supports for the walk will hold moisture and cause decay, both in the supports and in the roofing. The better method is to make the roof good enough so that it can be walked on, and also so that snow will not have to be removed except in case of a blizzard, in which case a board walk will not prevent damage from shovels.

The fact that wood sash is being removed in some places and metal sash substituted only indicates that the owners have been convinced that their troubles are going to be cured by the substitution. I am inclined to think that their troubles will be augmented.

A GOOD CONSTRUCTION

The design described in the following has proved almost faultless to date. The building is of semi-steel construction. The posts are steel I-beams anchored to concrete piers, and extend in one piece from piers to roof. The wood floor beams rest on, and are bolted to I-beam stringers, the stringers in turn being riveted to the posts. The floor planks are 4 inches thick, thoroughly spiked to floor beams, and at the wall ends are bolted to steel angles, which in turn are bolted to the brick walls. This construction makes the floor very firm, and at the same time sufficiently elastic for high-speed heavy looms.

The tying together of the roof and the posts is accomplished by light steel channels and angles, which form the shafting supports. The usual method for belting looms is from below the floor; in fact, it is absolutely necessary to so belt them for some classes of goods. The method causes less obstruction of light, but when it is possible to use the overhead belting, I think its advantages over the under-floor belting more than equal the disadvantages.

The pitch of the gutter is made by light cross pieces on top of the roof timbers. The curb is of 4-inch pine, the top of which is beveled at a sharp angle, to permit the water of condensation to readily run off the curb, and it is also grooved to form a drip edge for the water to drip into a small copper gutter, which is connected by means of a lead pipe to the regular roof down-take.

GUTTER CONSTRUCTION

The gutter proper is made as follows: The corners formed between the bottom of the gutter and the curb on one side, and between the gutter and the flat roof on the other, are filled with a fillet of wood of curved shape. Then sheet asbestos, 1/16 inch thick, is laid, extending two feet on the flat roof on one side and up to within three inches of the glass on the other side. On this asbestos is then laid galvanized iron of about No. 24 gage, extending to the same hights. This galvanized iron is nailed down. The object of it is to make the gutter firm to walk upon and especially to cover up any imperfections in the plank, as when the plank shrinks it will cover up the cracks, thus preventing the felt being broken when walked upon. The asbestos prevents moisture from the room reaching the galvanized iron, condensing, and dripping back into the room.

After the gutter is so prepared it is then ready to receive the regular five-ply asphalt or pitch roofing. It is well to lay an extra ply in the gutter, to increase the strength. The roofing should be thoroughly nailed and mopped. On the glass side, it should be brought up to within two inches of the glass. To protect this edge of the roofing, a flashing of galvanized iron was used, the edge of which was bent and sharpened and then driven into a cut in the curbing made by a special tool, shaped like a calking tool. Then it was nailed, with 1-inch spacing of nails, at the top and bottom. Slag, on account of its lightness and porosity, and consequent better holding qualities, was used to cover the gutter and flat portion of the roof. The curbing under the glass was thoroughly mopped, up to the glass.

The stiles or bars were made of white pine, firmly fastened to curb and ridge with brass screws. Both curbing and stiles were shellacked inside and out before they were painted. The painting throughout was with pure white lead and oil.

The glazing was double, the inside light being ¼-inch factory ribbed and the outside being plain double-thick glass. The outside glass was held from slipping downward by means of brass screws. Both

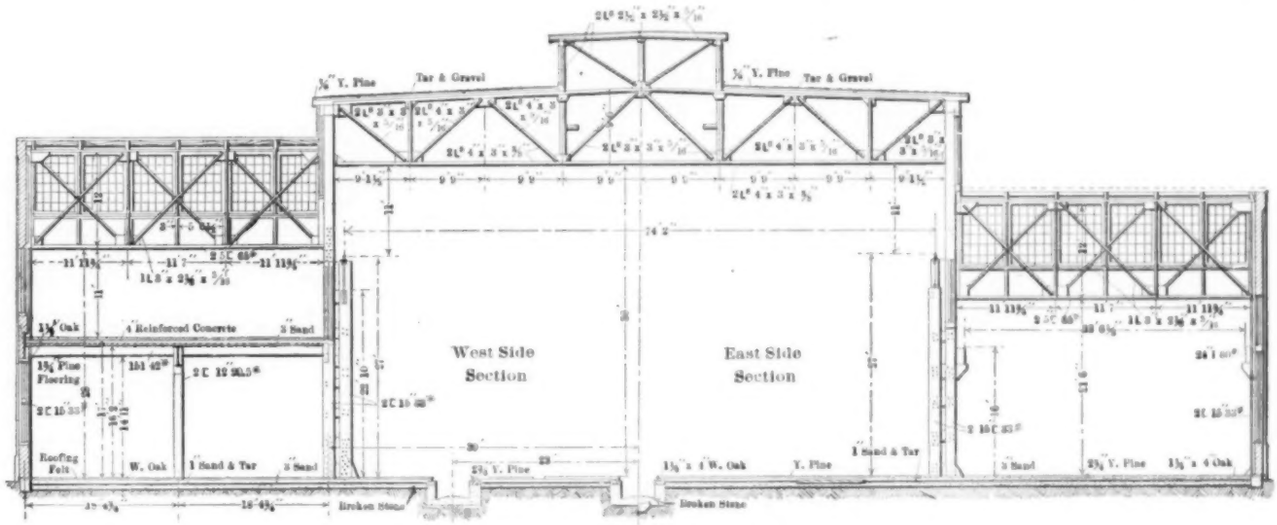


FIG. 13. SECTION OF LOCOMOTIVE SHOP

lights were thoroughly puttied with 33 per cent. white lead putty.

DRAINAGE

Roof down-takes were spaced about sixty feet apart to enable the gutters to empty themselves quickly. The down-takes are 4-inch copper pipes, carried down to the basement floor within the building posts, the posts for the down-take pipes being of a "built-up" channel section, whereas the regular posts are I-beams.

To prevent condensation, the copper roof bowl was covered with plastic magnesia and the down-take pipes were wrapped with asbestos. This piping was protected from damage by means of a galvanized iron shield.

VENTILATION AND HEATING

A weave room, especially for wool, should be thoroughly ventilated, first, to give healthful conditions, and second, to give even humidity throughout the room. In this room ventilation was accomplished by means of two steel-plate blowers, each driven by a motor, the entire equipment being located in the basement. Their combined capacity was equal to a ten-minute air change. It was so arranged that air could be drawn either from out of doors or from the basement, and air could be cooled by coming in contact with artesian well water. The air is discharged into the room in fifteen places, at a hight of about eight feet above the floor line, and is conducted from the room by means of innumerable openings near the floor line into the basement, by four revolving ventilators in each saw tooth, and by the windows. These arrangements permit all fresh air to be used, or all foul air, or any mixture of the two desired.

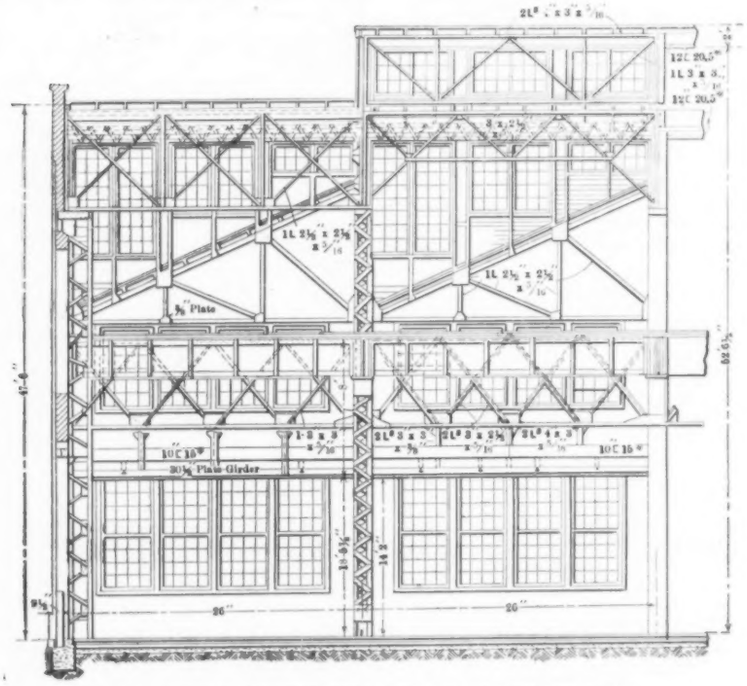


FIG. 14. PARTIAL LONGITUDINAL SECTION, LOCOMOTIVE SHOP

Roof ventilators have been a source of great annoyance on account of the condensation that occurs inside them, and the difficulty of making them tight at the roof line. To prevent the former, both the stationary parts of the revolving elbow were double walled, making 1-inch air spaces. To care for the latter, the roof joint was made tight with a copper flashing, the flat portion of which was large in area and was placed before the roofing was laid. The upper edge of the circular portion of the flashing was hammered over and soldered to the top edge of the stationary part of the cowl. To close the ventilators, a damper of special design was made, which hermetically seals them. It is nothing more or less than a stopper having a soft packing and controlled by a lever and rope. The connection between the rope and lever is by means of a spring, so that there is a constant pressure exerted against the packing. This damper has not been entirely satisfactory, for the air will work its way through the packing, condense in it, and drip back.

Heating is by direct radiation, two-thirds of the pipes being on the wall near the floor, and the balance at the ceiling. For some unaccountable reason, indirect heating has been much used for recent weave-shed work, but I have yet to see an indirect system that is satisfactory and economical. In my investigation I did not find one mill manager or superintendent who was at all satisfied with his indirect system.

SUMMARY

The lighting qualities of the saw-tooth roof skylight cannot be improved upon. Progress has been extremely slow to improve the mechanical defects of this skylight. The main points of the design I have submitted are:

a Careful design and construction to prevent leaks.

b No metallic connection between inside and outside air; therefore no uncontrolled condensation.

c Careful provision to remove the water of condensation on the glass.

d No uncontrolled openings between the inside and outside, which let in cold air.

e Minimum obstruction of light.

f The use of factory-ribbed glass, which diffuses the light so that what slight obstruction there is becomes unnoticeable.

Referring to Professor Sweet's discussion, I doubt not that the design used at the Straight Line shops is satisfactory for a machine shop, but I am very sure that it would not answer for textile work on account of the condensation on the cast-iron gutters. I should like to know just the exact detail that was used by Professor Sweet to prevent leaks in the joints between this gutter and flashing on one side, and the roof on the other side.

THE ANGLE OF THE GLASS

The consideration of the angle of glass, as related to the direct rays of the sun, is not nearly as important as Mr. Richmond's paper would lead one to think. Great care to secure the correct theoretical angle would be spoiled, in most cases, by the simple fact that absolute north exposure is seldom obtained, and as I have mentioned in the discussion of Mr. Hinds' paper, the slight amount and duration of direct sunlight obtained by an approximate north exposure and by about a 60-degree angle of glass, becomes entirely unnoticeable when factory-ribbed glass is used.

Properly proportioned forced ventilation will obviate the necessity of carrying a high degree of humidity in textile work, and therefore reduces considerably the extreme condensation effects, particularly the necessity of using a heat-insulating material on the roof other than 3-inch matched planking.

A SUMMARY OF SUGGESTIONS

L. H. Kunhardt said: Do not build the stories too low. Twelve to fourteen feet under the girders is, in my judgment, a minimum, and more is needed under many conditions. While a low story brings the glass and the light down nearer the work, and makes less space to heat in winter, on the other hand the ventilation is distinctly poorer and the heat of summer more oppressive, due to the sun's rays striking directly on the sloping roof planks, which are so near the heads of the employees.

Design the saw-teeth to face the north directly, or not more than a few degrees to the east of north, as the morning sun for a short time is not so objectionable as the afternoon sun. It is desirable to

exclude direct rays of sun whenever possible. The saw-teeth can be placed to run diagonally on a building, if it is necessary.

Ventilation by a fan system is to be preferred, as otherwise the middle of these wide buildings does not get fresh air. Excellent results are obtained in weaving rooms by having fans in dry basements to take the air from the basement and through windows and discharge it over the heating coils to the floor above. Metal ventilators of ample area at frequent intervals along the top of each saw-tooth are to be preferred to other methods of top ventilation, and these, in connection with the fans, will remove sufficient air to keep the atmosphere pure. I do not think ventilators alone are sufficient in these wide buildings; something is needed to keep the air moving. A combination of the fan system with direct heat may, perhaps, give best results. Pivoted or swinging sashes are apt to give trouble from leakage in driving storms, and dirt also blows in through them when open. In foundries and wet rooms very ample ventilation areas and good hight are necessary.

Leaks are a common fault, but can be overcome by maintaining a flat graveled space of from one to not over two feet between saw-teeth, and by flashing high and insisting on good workmanship and materials. Continuous saw-teeth have less chance for leakage than a number of short ones, but on the other hand, when they run longitudinally on a long building they need to be broken up at intervals to allow access across the roof, in case of fire or for removal of snow in severe storms. By bringing saw-teeth to the side walls and extending the side walls up, the side windows become unnecessary, and there are then absolutely no shadows. Condensation gutters with provision for carrying water outside have been obstructed by freezing if not properly designed therefor, and are sometimes drained to a point inside the building. The bottom of the sash should be horizontal and not follow the slope of the roof. Galvanized-iron sash, I think, is to be preferred to wood, as it is stiffer. The putty does not come out as in wood sash, and the sash does not rot as any wood sash is inclined to do, especially when not vertical. All galvanized iron is, however, poor at its best, and paint has to be depended upon to prevent rusting out. On this point practice varies. Wood sash is, of course, cheaper in first cost.

Ribbed glass with ribs vertical and on the inside, is to be preferred. The sloping glass in saw-teeth probably keeps cleaner under the same conditions, both inside and outside, than vertical glass in the ordinary monitor roof.

Saw-tooth roofs cost more, but not so much more that the added expense is not fully warranted for all rooms where excellent light, well diffused, is to be desired. The cost of artificial lighting under ordinary monitor roofs or in rooms with side windows only is considerably more, due to the larger number of hours such light is required, and this is a fixed charge. As one man expresses it, he has "more light at less cost" under his saw-tooth roof.

Roofs should be built of plank not less than 3 inches in thickness on wide bays—timbers 8 feet to 10 feet on centers. The light purlins or joists on heavy trusses 20 feet or more on centers ordinarily present no advantages over lighter trusses 8 to 10 feet on centers with plank spiked directly to them. The smooth roofs overhead are in every way the best. Hollow-in roofs are not necessary and only a very few factories have them; their use is not justified and the roof is, I believe, distinctly poorer. A good thick roof is cooler in summer and requires much less heat in winter than a thin one, perhaps more than a hollow one, but not, I think, enough more to make the use of hollows advisable when considering their undesirable features.

G. R. Henderson said: Mr. Hinds refers to the proper angle for placing the skylights in the saw-tooth, and while, no doubt, this angle is correct from a theoretical point of view, as far as proper diffusion of the light is concerned, yet from practical considerations, in connection with the structure of a building, it is sometimes desirable to place these windows vertically. This will be illustrated by the accompanying cuts, which represent a locomotive, erecting and machine shop now being constructed by the Missouri, Kansas & Texas Railway from plans prepared by the writer. Fig. 10 shows the west elevation, and Fig. 11 the east elevation. The saw-tooth construction will be noticed on each side of the central or higher section, and it will be seen that the windows in this saw-tooth are placed in a vertical plane. Fig. 12 makes the arrangement somewhat clearer, and while the saw-tooth windows are not actually shown, they are located at the opposite side of the portion where the tiling is indicated.

In Fig. 13 a section of the building is shown in which it will be noticed that the saw-tooth windows are placed close to a horizontal truss. In designing this building to stand the heavy winds which exist upon the Western prairies, it was found that by utilizing this truss as a portal bracing, considerably less material was needed in the building than if this truss were omitted or disposed of in some other fashion. The depth of truss being 12 feet, it gives a very great amount of rigidity to the structure and at the same time lends itself very nicely to supporting the triangular trusses which appear in Fig. 14, the hypotenuse of which supports the tile roofing, and the vertical sides constitute the window face of the saw-tooth. Four triangular trusses are carried from these parallel trusses, one at each row of columns and one at each of the two middle apices. As the high end of the triangular truss is attached to one side of these parallel trusses, the top cord is properly stiffened, and at the same time the lower cord of the triangular truss is designed so that shafting timbers, etc., can be suspended from it, making not only a rigid roof construction, but also a suitable support for shafting.

This construction, we think, works out much better in a building of this sort than if the skylight windows were inclined. The windows can also be made in the form of ordinary glazed sash, thereby reducing the cost and decreasing the danger of leakage, and enabling us at the same time to construct a building of great stiffness and transverse strength, without interfering with the lighting qualities.

Writing Business Letters

"I know," said a business man of wide experience, "how crowded with studies the schools are now, and I should be loath to recommend the introduction of any new ones; but I do wish sometimes that the boys and girls who are giving time to so many little fads could be induced to give more to the art of writing letters."

He did not refer to the mere art of writing correct English or the art of writing an interesting personal letter, but to the preparation of really good business letters, in which the matter in hand should be treated not only clearly and concisely but also courteously.

The need he mentioned is one which is felt by thousands of business men, and may well claim the attention of young people of both sexes who look forward to business life. The ability to write intelligibly is not rare, but the capacity to write in such a way as to produce a pleasant personal feelng for the house one represents is extremely rare.

Many writers fail in the matter of courtesy—either in the way of constant omission of articles and constant abbreviation, or, more commonly, in neglecting to give the other man the benefit of the doubt. In other words, the fault with most business letters is a fault of poor manners rather than of mental deficiency.

"Never, in any circumstances, allow your first letter, in a case of difference, to be harsh or discourteous," said a business man to one of his clerks. "No matter how much you think the man has injured us, give him the benefit of the doubt. Assume that he has made a mistake rather than that he has misrepresented. To take the other course is to enter a blind alley. You may have to turn around to get out of it."—*Youth's Companion.*

The Paris subway, like that in New York City, is presenting a troublesome ventilation problem. Chimneys are not sufficient, power-driven fans make objectionable strong drafts.

THE ETHICS OF TRADE SECRETS

BY FREDERICK P. FISH

Below we continue and conclude the publication of Mr. Fish's address delivered before the American Society of Mechanical Engineers, January 8.

THE COMMON LAW

It is one of the glories of the common law that common fairness and common honesty are the basis of most of its rules. Occasionally a new situation arises in which the law finds itself so hampered with the technicalities inherent in any definite system of jurisprudence as not to be able to deal as it would like with the new state of facts that have arisen. This is almost always because the state of facts is so radically new. It is one outside of the ordinary trend of the law. When such instances arise, the time for legislation has come.

But the courts have had no difficulty in the case of trade secrets. Recognizing the propriety of the proposition that they should be protected in cases where breach of confidence or breach of contract was involved, exact and well defined principles with which the law was familiar led to intervention by the courts to see that that was done which was right.

While such cases ordinarily are brought in courts of equity, because, as a rule, an injunction is sought, an action at law may be brought for damages. [The speaker here cited a number of cases in which the decisions enforced the following law.]

1. The injunction will run, not only against the employee, but against those who, with knowledge of the confidential relations, have induced him to betray the secrets.

2. The vendee of the secret has the same right as the inventor of the secret and may bring a bill against a former employee of the vendor, who acquired the secret in confidence, before the sale, provided the employee attempts to divulge the secret wrongfully.

3. News-agency contract, by which the plaintiff sent news to its subscribers under contract not to divulge it is enforced in equity.

4. Contracts of a commercial house must be kept secret by a clerk.

5. Forms and materials for printing advertisements in plaintiff's publication cannot be used by his agents for a rival publication.

6. A confidential attorney's clerk is enjoined from publishing extracts from books and papers of his employers or of their clients.

7. A law pupil has a right to retain copies of precedents in a barrister's or conveyancer's office.

8. Order-books containing customers' names cannot be copied by an employee to use later in his own business for soliciting orders.

9. A tailor's assistant cannot take away patterns of clothes of employer's customers when he sets up for himself in order to induce those customers to resort to him.

Analogous cases which throw light on the principle are the following:

10. One who makes copies of a drawing under contract can not make extra copies to sell in competition.

11. A photographer who takes a photograph to furnish customers with copies cannot sell or exhibit extra copies.

Perhaps as comprehensive a statement of the general law as any is that of Mr. Justice Story in 2 Story's Equity, Sec. 952, as follows:

"Courts of equity will restrain a party from making a disclosure of secrets communicated to him in the course of a confidential employment. And it matters not, in such cases whether the secrets are secrets of trade or secrets of title, or any other secrets of the party important to his interests."

The doctrine of these cases was first advanced something less than one hundred years ago. In two early cases Lord Chancellor Eldon refused relief; in one (Newbury v. James, 2 Merivale 446) because he did not see how he could pass upon the question without bringing out the secret in the court proceedings, in which case it would be disclosed and therefore cease to be a secret. The courts have been able to deal with this difficulty. In the second case (Williams v. Williams, 3 Merivale 157) he refused relief, first because the defendant, in his answer, denied that there was any secret; and, second, because he did not feel that the particular medicinal secret involved was of such a character as to entitle the plaintiff to the good offices of a court of equity. In a third case, however (Yovatt v. Winyard), he granted the injunction asked, and the law has been practically settled since that time.

LAW NOT QUITE COMPLETE

In some respects, the law of trade secrets does not seem quite complete. There have not been sufficient cases arising under sufficiently varying conditions to enable all aspects of the law to be worked out.

For example, under the decisions of the courts there seems to be practically no limit as to the character of the subject matter which may be treated and protected as trade secrets. They may be of small or large importance; they may or may not involve great novelty or real inventive quality. They may be mere business expedients which have a trade value because of their convenience, or because they record useful information. Unlike a patentable invention, it does not seem necessary that they should be "new" as well as useful.

One eminent judge has decided that a trade secret which had actually been described in an expired patent (there being no evidence that it had ever been practised) was entitled to protection (Benton v. Ward, 59 Fed. Rep. 411-413). At first sight, it might seem that all that was required was that there should be a secret plan or method or device of any kind, to entitle its possessor to the limited protection which the law gives.

WHAT ARE PROPERLY TRADE SECRETS

I doubt, however, if such is ultimately determined to be the law. When cases arise which require a close analysis of the question, it is probable that the courts will decide that there is something necessary over and above the mere question of secrecy, to justify the exercise of the power of the court to prevent the use or disclosure by one who acquired his knowledge in confidence or while under contract.

An employer may have a certain routine in dealing with his help, which he thinks aids him in his relations with them. He may give them certain favors that they appreciate. Can things like these be a trade secret which the law will protect? He may have discovered that a certain make of lathe or of sewing machine is better adapted to the work of his factory than any other. Cannot an employee who leaves him, fairly take away that information and use it as part of his stock of trade? There must be some limitation to the things that can really be treated as trade secrets. Exactly as the courts have been forced to determine in special cases whether or not an alleged invention had patentable quality or was merely the result of the intelligent exercise of the skill of the art, so they will probably at some time determine that it is not everything which a man originates or acquires and uses for his own advantage, that is capable of becoming the sort of a trade secret which is entitled to protection. Just where the line will be drawn cannot be foreseen. It may be that a distinction will be made between those things that come into the art by a mere small development of old ideas and the exercise of ordinary trade knowledge and skill, and those that result from some degree of original thought, even if it is not of the grade which under the narrow terms of our statutes is required to constitute patentable invention. It seems clear that as long as the present views of the courts prevail, many things will be protected as trade secrets which could never be the subject of letters patent.

MUST NOT BE VAGUE IN CHARACTER

Again, it does not seem as if a device or method or plan should be respected as a trade secret unless it is specific in its character, and capable of exact description. It is not reasonable that vague gen-

eral methods, or indefinite, ill-appreciated peculiarities of procedure should be dignified as capable of becoming in effect property.

The decisions have but little to say on such points. The issues in the decided cases have been too clear to make it necessary to develop them. Some time considerations like these will come up in special cases, and the law will be started on a line of discrimination and distinction which will ultimately define the limitations, if any should exist.

Certain other propositions which are not very explicitly developed in the decisions of the courts or in the text-books, in my opinion, are or ought to be a part of the law.

SHOULD BE REGARDED AND TREATED AS A SECRET

It is well settled that the alleged secret must be a real secret. I believe, however, that before the courts should intervene to protect an alleged trade secret it should appear that it was not only regarded as secret, but that it was distinctly treated carefully as such and guarded by the possessor of it. It should not be enough that he has had it in mind to call it a trade secret, if he ever needed to invoke the protection of the law. He must have taken all necessary and reasonable precautions to prevent its disclosure. Moreover, it does not seem proper that he should have redress against his employees and associates unless it is made to appear that they *knew*, while occupying the fiduciary relation which gave them the opportunity to learn the secret, that the specific thing now called a secret was in fact regarded and treated as a secret. It should not be enough that one man has worked for another. The employee has a perfect right to grow with his experience. He has a right to carry away for general use everything that he learns in his place of employment, except trade secrets. The public interest requires this as much as it requires that trade secrets should be respected. The employee or associate should be notified of the exact trade secret, that he may know what results of his experience he can and what he cannot take away and use freely. Eternal vigilance and definite effort should be one price of the investment of a trade secret with any of the qualities of property.

LOYALTY AND GOOD FAITH

With these qualifications, some of which are perhaps not fully elaborated in the opinion of the judges, there seems no reason to doubt that the law is thoroughly consistent with sound ethical principles. It is based on a view of what is for the interest of the community, which has commended itself to the judgment of mankind from the beginning. In its application, it consists only of loyalty and good faith, loyalty to one's employer and one's associate and to one's word, and to the plain, good faith which is always expected where contract or fiduciary relations are established. To test this question, let us suppose the law to be suddenly changed. I can conceive of only a few directions in which a change of any moment is possible. One would be to the effect that the possessor of a trade secret should publish it to the world so that all might have the advantage of it. Such a law would be incapable of enforcement, for the man who has a thought or an idea cannot be forced to express it. If the rule were established that one who practises his thought or his idea thereby irrevocably gave it to the public, trade secrets would perhaps be eliminated to a large extent, and so would any progress in the art that is based upon them, for the possessors of them would have none of the stimulus to develop them into practical form and make them useful and profitable. That is based upon the chance of monopolizing them. Surely, this would result in no benefit to the community. Again, the law might be modified so as to remove the present restrictions against the disclosure of a trade secret by one who thereby is guilty of a breach of trust or of contract. So long as we maintain our present standards of right and wrong, so long as we value and insist upon loyalty and good faith, would not such a change in the law seem to us inconsistent with all that is good in human nature, and the application of a principle which is most distinctly immoral? If an employee or trusted associate, for selfish ends, can be disloyal in the matter of a trade secret known to him as such, and the knowledge of which he would never have acquired except through his relation to the possessor of the secret, why should he be loyal in any other matter? It is conceivable that disloyalty as to a trade secret might be the most serious conceivable blow to the one who had given confidence, expecting honesty and fair dealing in return. I trust that the day will never come when the courts will find it necessary to modify in this way a principle of law which to so great an extent emphasizes good faith, which depends so much upon a recognition of the obligation to keep agreements, which is founded upon a sound public sentiment and the underlying virtues of loyalty and fair dealing.

OBLIGATION OF DOING RIGHT

Believing as I do that the law of trade secrets is fundamentally right, and in accord with sound ethical and social principles, at least as gaged by our present standards, I have not turned aside to consider the possible objections to the views that have prevailed. It seems to me that those objections are based largely upon a consideration of the obvious hardships involved in the situation. It is a burden that one who knows a useful thing should not have full power to utilize it. Is not this true of every legal restriction upon the individual? It is *often* a serious matter for one to carry out a contract. From a narrow and material point of view, it is frequently disadvantageous to keep faith and respect confidence. Every property right implies that something is monopolized by one or by a few that many others would like to have. The hardship in not being able to utilize knowledge of a trade secret, obtained by way of confidence or contract, express or implied, is no different from that resulting from a multitude of other obligations that are constantly arising, some from our voluntary acts and others from the restrictive operation of laws and usages that have been developed for the common good, and that are forced upon all of us whether we like it or not.

It must not be forgotten that no man need place himself under the embarrassment of knowing a trade secret unless he chooses. Each of us is free to refuse the employment or the relationship or the contract from which such knowledge would come. If we do not refuse, we must, as in all other relations in life, accept the situation as a whole, with its burdens as well as its advantages. There is nothing special, as to trade secrets, in this regard.

Neither must it be forgotten that the right to protection in the use of a trade secret is a general right. It is sometimes suggested that while the rules of law, as I have defined them, were adapted to a former condition of things, they are not in harmony with our present industrial situation. I do not think that such is the case.

A PERMANENTLY SOUND PRINCIPLE

It is true that in the early years of the last century, when the trade secret of today, in its legal relations, was formulated by the courts as a logical development of the general principles of law, the units of trade were small. Trade secrets were then in the possession of small manufacturers, for there were no large ones. They were often heirlooms, passing from father to son, for generations. We all know how conditions have changed. In so far as trade secrets play any part in our industries of today, they are necessarily, to a large extent, features of our modern corporation and factory system, although there are still many secrets in the possession of individuals who use them for their own advantage, sometimes selling the knowledge of them to several concerns, always under a pledge of secrecy which the courts would enforce. I do not see how these changes in industrial conditions affect the question under discussion. The reasons which led to the original protection of such secrets against breach of contract or breach of faith, one hundred years ago, are sound today. If such protection was fair and reasonable then, it is fair and reasonable now. If it was then in the public interest as leading to the promotion of the useful arts, the same is true today. If such

secrets were entitled to recognition in the last century, it was because their existence and support were in harmony with public sentiment. Unless that public sentiment has changed, they are still in harmony with it. I do not believe that it has changed.

The law on the subject is the same whether the secret is of large or small importance, whether it is possessed by any individual or by a corporation. We should not forget that any one of us in this room, and any workman in any factory in the land, may light upon such a secret. If he does, it will have the protection of the law. It may be used by the one who possesses it, or he may by contract determine the manner and extent of its use. In any case he will have control of it as a reward for his intelligence or forethought in coming into possession of it. He will have encouragement to put it in use, in which case the public will get a benefit from it which they might otherwise never have received.

PATENTS

A consideration of possibly more moment is that there is offered to the originator of certain special forms of industrial secrets, or to his assignee, the protection afforded by the grant of letters patent. It may be contended that the opportunity to patent an invention is all the encouragement to the promotion of the useful arts that is required in the public interest, and that there should be no other reward for the origination of a new thought or of a new method or device than that given by a patent. Passing for a moment the point that only a small class of useful ideas is capable of receiving the benefit of letters patent and referring only to things that are patentable, such a view does not seem to me fair or reasonable. Why should a man be forced, against his will, to publish what is in his mind? Ought he not to be allowed to determine for himself what is for his interest? Should he not be free to decide whether he is likely to get an adequate reward, under the patent act, if he does make the publication? If he concludes that such will probably not be the case, should he not be at liberty to use his new idea as a secret in his business, or in some business with which he establishes relations, taking his chances as to the secret being discovered?

The whole law of patents implies the right of a man to keep as a secret that industrial improvement which he has conceived. It is because that right is recognized that patent laws exist. They say in effect: "You, the inventor, have a trade secret which is, among other things, new, useful and the result of invention. You may keep this secret if you can, and so long as it is kept secret you and those claiming under you alone may use it. If your secret is discovered without breach of faith, as may be the case at any moment, you lose it absolutely. Do you not prefer to make a contract under the patent law by the terms of which you are to publish your invention in the best form known to you, and in consideration of that publication secure a right, which you cannot otherwise have, and which shall be enforceable by law, to prevent the use of your new idea by any others without your consent for a limited term, say seventeen years? You will, to be sure, sacrifice the chance you now have of keeping your invention, for an indefinite time, a secret and therefore in your own control, but in return you get the right to invoke the aid of the law to restrain any use without your consent for a certain period. Which course do you think most for your advantage?"

If all trade secrets could be patented, and if the patent law was as satisfactory in substance and in administration as we wish it might be, there can be no question which course would be the most advantageous for the one who possesses the secret. A patent would be enormously more satisfactory than the chance of preserving a trade secret. The latter, at the best, is a most uncertain and insecure property. It may be lost so as to be open for use by anyone, in innumerable ways which are not within the control of the rules of law to which I have referred. It may be disclosed by accident by the one who possesses it, or unintentionally in such a way as to involve no breach of faith by those who know it.

RIGHTS OF A THIRD PARTY

As I understand the decisions, even unfairness or want of faith on the part of one who receives knowledge of the secret in confidence, does not make it impossible for him, before he is enjoined by the courts, to disseminate the information so that those who get it from him may use it freely. A person who has notice of the incapacity of his informant to violate confidence, or one who has given no consideration for the information, would be subject to injunction. On the other hand, a *bona fide* purchaser of the secret who had no notice of any breach of confidence or of contract on the part of the one who sold him the information for value, could, I believe, use the information without interference from the courts. He, as a *bona fide* purchaser for value and without notice, would have an equity equal to that of the possessor of the secret. Under such circumstances the courts are not likely to interfere.

DISCLOSURE IN TRADE JOURNALS

If a disclosure was wrongfully made in trade journals or otherwise, it would be a difficult, almost an impossible task for the one whose rights had been violated to secure redress against the entire public who had read of the secret and who were actually innocent of any breach of faith. Moreover, where there is a trade secret, the fact that it exists is likely to be known throughout the trade, and each competitor has the full right to find the secret for himself, using all information as to its nature and the results from it that he can get from an inspection of the product, from speculation, or in any fair way. I will say nothing as to unfair ways that might be employed and which might be carried out with effect, but so shrewdly as to evade the law. No man would prefer a trade secret to a patent if the only question was one between the chance of keeping his device or method to himself indefinitely without publication, and publication with a reasonable certainty of protection during a limited term. But the issue does not come up in this simple fashion.

In the first place, as is shown by the cases I have cited, many trade secrets are not of a patentable character. It may be that the number of these will be reduced as the law develops. Many such should surely be capable of protection in some way. There is no other possible way than through the present rules of law to which I have referred. Most of these unpatentable ideas are of relatively small importance.

SECRECY AND LETTERS PATENT COMPARED

Of the valuable trade secrets, such as new mechanical or chemical processes, some undoubtedly have or once had patentable quality.

Should the taking of a patent be the only possible protection for these? I think not.

There are many valid reasons why the discoverer of a new industrial process may well determine not merely that it is for his interest to take his chances of keeping it secret rather than to publish it in a patent, but that the latter course might lead to disaster. While it is generally, but not always, easy to prove an act of infringement of a patent on a product, or a tool, or a machine, it is often practically impossible to obtain legal proof of the process employed by one who is believed to infringe a process patent. The infringer is very apt to be able to keep his infringement an undiscoverable secret. I am inclined to the belief that a substantial part of the important and valuable trade secrets now in use would, if patented, be used without much, if any, chance of redress on the part of the patent owner. At any rate, if the one who controls the secret fears that he could not prove infringement of a patent, is it contrary to public policy that he should be allowed to take his chances of keeping what he has discovered a trade secret rather than run the risk of losing it altogether by publishing it?

Again, nothing can be patented unless it involves invention. Pages have been written by way of defining invention. Many of our greatest judges have given all possible thought to the subject. It is still indefinite, however. The judgment of the patent office on the point is every day overruled by the courts. No lawyer can ad-

vise with any confidence in a great number of the cases that come before him.

Inasmuch as a trade secret is a man's own, to use or not as he pleases, can it be required that he should absolutely give up his opportunity to utilize his idea for his own benefit, and incidentally for the benefit of the public, in his own factory and under the seal of secrecy, and take a patent which might be declared invalid for want of invention, no matter how useful and meritorious the subject matter might be? In like manner, when one takes a patent, he exposes himself to the danger of having it declared invalid on any of an innumerable number of other grounds which he cannot foresee or guard against. If he prefers to keep what he has a secret, if he can, is there any substantial ground why he should not be allowed to do so?

Moreover, admirable and effective as is our patent law, there are involved in its administration many difficulties other than that of proving infringement. In practice it is most cumbersome and expensive. Years are likely to elapse before a test case can be determined, during which infringement becomes general. Under our present court organization, with no single appellate tribunal covering the whole country, a victory for the patentee in the first case does not settle the situation. He may have to sue many infringers in many parts of the land before his rights are generally recognized.

Our patent system is probably the best in the world, and it is certainly administered by courts of great intelligence and high character. The difficulties to which I have referred, and other like difficulties, are inherent in any patent system. Certainly it would require strong considerations of public policy to force an inventor to take what is offered by the patent law as his only form of reward when he may see clearly that the new thing which he has may not stand the strain of patent litigation, but may be profitable to him, and useful to the community if he can keep it for a reasonable time as a trade secret.

NO LEGISLATION ON TRADE SECRETS

It is to me somewhat significant that the legislatures of England and America, which have many times dealt with the patent law, have never directly touched the subject of trade secrets. They seem to have recognized the fairness and justice of the common-law rules on the subject, and that the only course which would commend itself to a sound public sentiment was to make the patent laws so attractive as to induce the owners of patentable trade secrets to publish them in consideration of the patent grant. In this they have to a large extent succeeded. There are an innumerable number of patents, and a comparatively small number of trade secrets. It is only in a few special classes of subjects matter that the patent is not a more attractive reward for the new contribution to industrial progress than is the limited protection given by the law to a trade secret. There are few situations in which the secret can be kept at all, even if everyone exercises the utmost possible good faith. It is impossible in the case of a product, whether chemical or mechanical, and more than difficult in the case of tools and machinery. It is only with processes which are practised in a factory, and which are not disclosed by a study of the product that there is any substantial chance of maintaining secrecy. To a far less extent machines which are not generally distributed have some chance of being kept secret.

If a man elects in those few cases not to publish but to take his chances, can there be any real objection to his pursuing that course? It is certainly inconvenient and annoying to some extent. It is a real personal hardship that a workman or engineer who has learned the secret under such conditions that he must respect it, cannot utilize it in his subsequent work. It undoubtedly holds back the progress of the useful arts to some extent that the whole world is not free to practise it and to improve it. But this, in theory, is equally true as to things that are patented, during the long term of seventeen years in which no improvement on the thing patented can be rightfully used, except by the patentee or those claiming under him. It would be true of any monopoly given the inventor or deviser of a new thing as a reward. But the progress of the useful arts is, I believe, enormously promoted by the patent system. I doubt if it is interfered with to any appreciable extent by the requirement of good faith in those who have in confidence become acquainted with trade secrets.

On the other hand, I believe that sound business generally and the comparatively few arts in which such secrets are of any importance are definitely promoted by the fact that the law aids in preventing disclosures based upon bad faith.

TRADE SECRETS, PATENTS, COPYRIGHTS

I have referred to the analogy between trade secrets and patent rights on the one hand, and the privileges of copyright on the other. The analogy is significant as showing the logic of the law, and the basis upon which it has been developed.

The copyright which protects a publication of any kind is purely statutory, exactly as is the protection given by letters patent. It is an inducement to publish, that is, to give to the world what might otherwise never be published. As in the case of a patent, it secures to the owner a monopoly for the thing published for a limited term, after which the field is open to everyone. It is a distinct recognition of the author's right not to publish unless he chooses.

But in addition to the statutory copyright, there is a common-law copyright, which does not deal with publications at all. This protects the unpublished book, or piece of music, or play, or picture, and even the letters which one writes, against publication or exhibition by others than the person who originated them or secured the lawful control of them as unpublished material. The protection is the same as that in the case of a trade secret. The right of the owner to publish or not, as he pleases, is recognized as absolute. He may make what private use of the unpublished material he chooses. He loses all common-law protection if and when he publishes. Up to that time those whom he takes into his confidence must respect his sole and exclusive control of the unpublished matter. They cannot publish it nor can they use it without his consent. It is obvious how close this branch of copyright law is to that governing trade secrets.

This is only another illustration of an application of the principles for which the courts have contended in the development of the law as to trade secrets. In both cases the authorities are substantially a unit, and their views seem supported by public opinion and consistent with sound business policy.

THE BROAD VIEW

Such are my views as to the ethics of trade secrets. They are those of the courts, and I believe of the public. I recognize that all industrial questions are now under investigation. Much good will come from a fresh study of them in their relations to modern social, political and economic conditions. There is no class of men in our land more capable of coming to sound conclusions on such subjects than that represented by the society which I now have the honor of addressing. There are no men whose influence is greater.

The question we have been considering is only one of many as to which the community has had settled views which were reflected in the unanimous findings of the courts. As to some of those questions, it may be that we are on the verge of marked changes of thought which may result in equally great modifications of what have seemed to be sound and permanent industrial and business principles, and in the applications of those principles. The engineers of the United States will surely be on the right side of the discussions of these subjects, and of any political or judicial action which follows those discussions. It may be well in every case to consider the grounds for the doctrine that has prevailed before condemning it altogether. It will always be necessary to determine whether the criticism should not be directed to the applications of the doctrine, that is, to the special cases, rather than to the doctrine itself. In the matter of the trade secret, there may be hardship or even wrong in special cases. If so,

let us find out how to deal with the subject so as to retain what is right and to eliminate what is wrong. A modification of the present rules of law may perhaps be essential to that end.

The important thing for us to determine is whether or not the prevailing views as exemplified in the decisions of the courts are not fundamentally sound, based as they purport to be on principles of thought and action that are in harmony with elementary rules of public policy and good morals. If they *are* right they should be sustained. For myself, and speaking generally, I cannot see what fairer or more reasonable views could be advanced in their stead.

A Forward Movement in the American Society of Mechanical Engineers

The very successful annual convention of the American Society of Mechanical Engineers, held in New York City last week, impels us to call attention to the notable advance which this society is making. The total registration in attendance at last week's meeting was 1325, breaking all records for convention registration, not only for this society, but for any other American engineering society, so far as we recall. No other engineering society compares with the Mechanical Engineers in the matter of convention attendance. One reason for this, of course, is that the membership of the civil and mining engineering societies is much more widely scattered, and also that a large proportion of the mechanical engineers are able to combine business with pleasure in attending the annual meeting at New York City.

Making all allowance for such conditions as these, however, it is certainly true that the enormous attendance at the Mechanical Engineers' conventions shows a lively interest by the members in the society's work.

It is, of course, recognized that one of the principal functions of this and of any engineering society is the promotion of acquaintance and social intercourse among the men engaged in the same line of work. The social features have always been prominent in this society and account in some measure for the very large attendance at the society's conventions. It still remains true, however, of this as of other national engineering societies, that the majority of the members are seldom able to attend meetings of the society, and the value of their society membership—or what they get, in return for their annual dues of $15—is measured by the value of the society's publications.

It is therefore a matter of great importance to the society's welfare that the quality of the papers presented at the meeting last week, rating them as a whole, was far in advance of those at any previous meeting in a long time. In addition to this, the discussion on the papers was of real importance and value, and the whole meeting represented a most praiseworthy result in valuable technical work accomplished.

Like most valuable results, the success of last week's meeting was not brought about by accident, nor did it, like Topsy, "just growed." It represented some of the results of the work which Frederick W. Taylor has done for the society during the year in which he has been its executive head.

The man who is chosen to the presidential office of a national engineering society commonly regards the matter chiefly in the light of receiving a great honor at the hands of his professional brethren. He attends and presides at meetings of the society and its governing body, when he can conveniently do so, and lends such dignity as he can to the office. There is,

CALVIN W. RICE, SECRETARY A.S.M.E.

however, another light in which to view the office of president, and that is as the executive head of a business corporation receiving and expending nearly $50,000 a year and accountable to several thousand shareholders for the economical and efficient handling of this income.

As we have said above, President Taylor has been the executive head of the society. He has expended a very considerable amount of time and money in reorganizing the society's business affairs. Its work in printing and publication has been carefully investigated by an expert employed by President Taylor at his own expense, and changes in methods and in contracts for printing and publication have been made which will effect a large saving in the society's expenditures. In connection with this, the old plan of issuing advance copies of papers just prior to each meeting has been abandoned, and in its place the publication has begun of a monthly "Proceedings," in which the papers are printed as fast as received and, of course, before their presentation at a meeting. Coincident with these other changes has been the installation of a new secretary, Calvin W. Rice, late consulting engineer of the General Electric Company. While Mr. Rice has been serving as assistant secretary since last April, and was only advanced to the position of secretary at the annual meeting last week, it is but giving credit where credit is justly due to say that the high quality of the papers and discussions at last week's meeting was largely due to Mr. Rice's initiative and energy.

It is something of an innovation to select as secretary of an engineering society an engineer of high standing in practical engineering work, and have him devote his entire time to the society's affairs. A frequent criticism of the Mechanical Engineers' Society in the past has been that the papers read before it were too largely contributed by professors and dealt with theoretical matters or laboratory tests rather than with practical present-day work of the engineer. It may be expected that the selection as secretary of a practical engineer of wide experience will have a strong influence to reform the society's work in this particular.

We may set down here that the task of procuring first-rate technical literature for publication is harder in this field by far than it is in the field of civil engineering. Of third-rate, fourth-rate, and so on down the scale, an infinite amount is to be had for the asking—or without the asking. There are plenty of people who want to advertise themselves or their products. First-rate literature, however, is the sort that is of direct practical usefulness to the working engineer, and the attempt to secure this sort of papers is met too often by the refusal of business firms to permit the data obtained by engineers in their employ to be made public. This refusal, be it said, is due more frequently to red tape and to cast-iron rules regarding secrecy, than to any real injury which would be done to commercial interests if the data in question were made public. Nevertheless, the condition referred to exists and must be dealt with by those who are tackling the job of making the American Society of Mechanical Engineers the useful aid to the profession that it ought to be. Mr. Rice, as secretary, is preëminently fitted for the work of educating our great industrial corporations to the advantages of technical publicity—of a different sort from that promoted by their own "publicity" men.

In another respect, too, the society is soon to enter on a new era in its existence. A few weeks hence it will leave the house on Thirty-first street, where it has been quartered for sixteen years, and move into the spacious new home of American engineering societies which has been created through Mr. Carnegie's generosity, and which is to be the home as well of the Mining Engineers and the Electrical Engineers, the two other "Founder Societies," and also of a number of

other engineering and scientific societies, of national or local scope.

The attractive features of this new headquarters, with the library and social facilities which will be there available, are certain, we believe, to attract a large number of new members to the organization.—*Engineering News.*

From the above, it will, we think, be plain that this is a good time to join the society. It ought to have a large increase in its membership, and there are many men doing mechanical engineering work who do not belong, but ought to.

As to the good work that has recently been done on behalf of the society, ex-President Taylor certainly deserves all the praise given him by our contemporary. During his administration he brought things to pass, and in doing it spared neither time, hard work, nor his private purse. As a member of the council, the executive committee, and chairman of the standardization committee, he still continues that work in the expectation of soon rounding out and completing it. In the doing of it he has had the help of other devoted members of the society not mentioned by our contemporary. Prominent among these is the man who undoubtedly wrote the editorial above quoted, Charles Whiting Baker, who, with Mr. Suplee, acted upon a committee charged with responsibility for improvement with respect to all that pertains to printing and the society's publications, which is where most of the money goes, and is a very important function of the society.

At the time of Mr. Rice's selection as the new secretary of the society, we gave (page 34, Vol. 29, Part 2) a sketch of his career and personality. Herewith we give his portrait from a photograph by Lafayette, of London.

Advancement of Apprentices

In 1903 Messrs. Richardsons, Westgarth and Company, Limited, Hartlepool, instituted a system for the advancement of their apprentices which was to be given a three-years' trial. The system took account of work in science and technical classes, and time-keeping, good conduct, progress, etc., in the works. Marks are given, the possible maximum depending on the number of subjects taken up in the classes. On the results of these marks the apprentice is given an advance in pay. The greatest number of marks obtained for the year ending September, 1906, are to the credit of a lad in the erecting shop, who thereby earns an advance of 14 pence per week. The apprentices who come next are in the turbine department, the drawing office, the electrical department and fitting shop. From the rise of 1 shilling 2 pence, mentioned above, the increments diminish in value till, in the case of some apprentices, only 6 pence per year increase has been earned.—*Engineering.*

A Project for Cheap Generation of Electricity at the Coal Mines with Possible Transmission to Philadelphia and New York

One of the greatest resources of a country is its store of coal. Although electrical engineers look forward hopefully to the development of water powers and the long-distance transmission of the energy so obtained, yet this is also a natural resource which is limited in quantity, and the utilization of which is subject to much stricter geographical limitations than that of the supply of fuel. It being, therefore, very important that we make the most of what we get from the mines, it would seem that political economists should note with satisfaction a project which appears to be taking tangible shape, having for its object the utilization of the vast banks of anthracite culm at the mines of Pennsylvania, a half century's accumulation of coal which it did not pay to ship to market, but which contains millions of tons of fuel. A new concern, to be known as the Harwood Transmission Company, which is now making application for a charter, proposes to erect at Harwood, Penn., a big power plant which will be supplied with cheap fuel from the accumulation of rice coal* and the slate banks, thus saving the cost of freight on the coal. The electric current to be generated here is to be transmitted to Reading, Allentown, Sunbury, Mauch Chunk, Pottsville, Shamokin, Bloomsburg, and other places in that region where electricity can be used with advantage, at, it is hoped, a cost which will enable the power to be sold for less than it can be developed by the consumers. According to the newspaper accounts of this project, the promoters will endeavor to attract manufacturers to the coal regions by the prospect of getting power much cheaper than it would cost in the big cities. Nevertheless, it is stated that the electrical energy may ultimately be transmitted from the mines to Philadelphia and New York, where it will become available for power, light and heat. Though the freight on a poor quality of coal is thus saved, a great quantity of metal for conductors would be necessary to carry out the scheme on a scale sufficiently large to make it worth while, and copper at present is an article whose cost is an item of the very highest importance. A good deal has been heard of schemes for supplying Washington and Baltimore with electric power generated at the falls of the Potomac and on the Susquehanna river; and the project of supplying Philadelphia, New York and the smaller neighboring cities with current from the mines of Pennsylvania would appear to be as promising, to say the least.

*Rice coal, otherwise known as No. 2 buckwheat, will pass over a screen with 3/16-inch perforations and through a screen with ⅝-inch perforations.

Industrial Insurance a Clumsy and Wasteful Institution

It may be doubted whether the improvements now effected will go far to convince the intelligent public that industrial insurance is not a very clumsy and wasteful institution. We do not remember that any disinterested writer who has ever looked into this field of our national economy has spoken of industrial insurance as anything more than a makeshift institution, only to be tolerated until some less wasteful system was found practicable. Industrial insurance is generally regarded as "thrift." Indeed one of its chief apostles has claimed for it that it is the greatest educational influence making for thrift that exists at the present day. Well, thrift and extravagance are relative terms. In the absence of a clear and authoritative line of demarcation between them, everybody can have his own opinion about an institution which compels a man to put up a dollar in order to get back 35 cents of it when he dies. Out of every dollar paid as premiums on industrial policies it has been calculated that 35 cents goes to death claims and another 35 cents to expenses of management. In 1905 the two companies above mentioned paid nearly as much for agency and home-office expenses as they paid to policyholders in the shape of claims. In the 29 years from 1876 to 1904, there was paid to the industrial insurance companies of this country, by way of premiums, $845,385,672. The losses paid back during the same period amount to $260,069,267. The rest of the money has either been spent in management expenses or has gone toward stockholders' dividends or toward the accumulation of assets and surplus.—Harold Seymour in *Moody's Magazine* for January.

Alcohol not Denaturized as a Motor-car Fuel in Persia

There is nothing like being an Eastern potentate when you are in what is called a "hat," though these parties usually, by the way, wear turbans or fezes. As for instance: *L'Eclair* tells the following tale with regard to the Shah of Persia's new motor-car, which reached Teheran shortly before the Shah fell sick. The Persian monarch wished to try the car almost before it had been unpacked. "O, King of Kings," said the Grand Vizier, "there is no spirit for driving the car." "What," replied the Shah, "no spirit? What about my old cognac of 1868! Bring me some bottles of it at once." This was done, and thus it came to pass that the motor-car of the Persian ruler was driven by bottles of cognac worth £2 per bottle.—*The Indian Textile Journal.*

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Strainers for Hydraulic Machines

Recently the necessity arose of devising some way to prevent dirt from passing into a number of hydraulically worked machines, as the strainer (if there was one at the intake end of the suction pipe through which the water supply was obtained) allowed dirt to pass into the pumps. This dirt, lodging under the valves, would not allow them to seat properly, thus preventing the proper pressure being maintained.

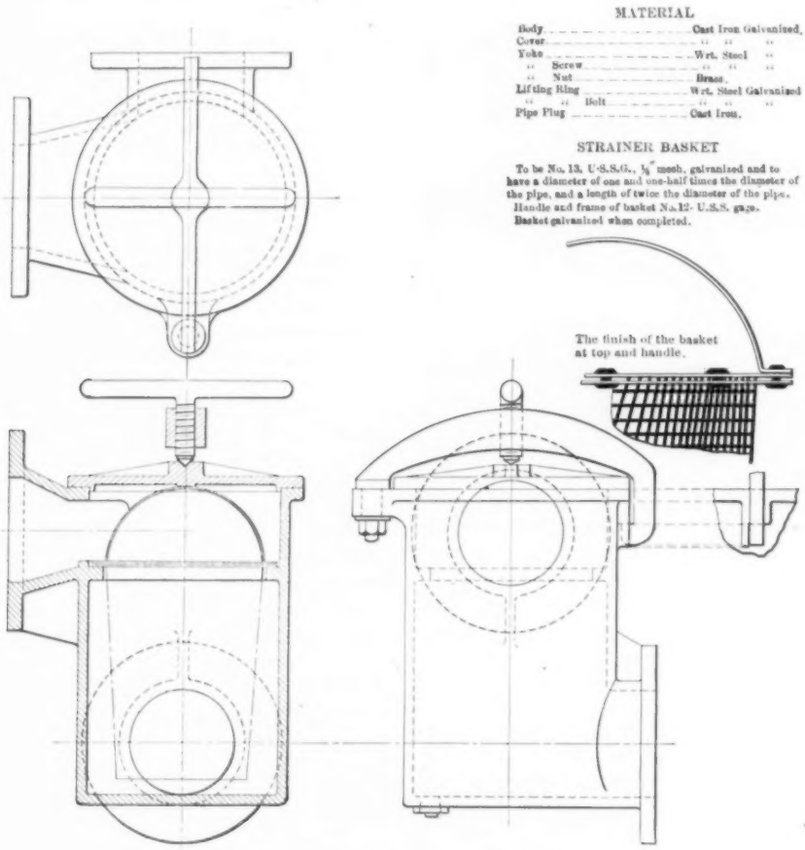

MATERIAL
Body ..... Cast Iron Galvanized.
Cover ..... " " "
Yoke ..... Wrt. Steel "
" Screw ..... " " "
" Nut ..... Brass.
Lifting Ring ..... Wrt. Steel Galvanized
" " Bolt ..... " " "
Pipe Plug ..... Cast Iron.
STRAINER BASKET
To be No. 13, U.S.S.G., ½" mesh, galvanized and to have a diameter of one and one-half times the diameter of the pipe, and a length of twice the diameter of the pipe. Handle and frame of basket No. 12- U.S.S. gage. Basket galvanized when completed.
The finish of the basket at top and handle.

FIG. I. STRAINER FOR HYDRAULIC MACHINES

A method used in marine work was suggested and proved entirely satisfactory. The method was as follows: The drains from the different compartments of a ship are led into one main suction, which in turn is connected through a system of controlling valves to a pump, generally termed the bilge pump. As a means for preventing the dirt from passing into the valves and pump, a type of strainer is used which is given the name of McComb strainer. I do not know the history of it, but McComb was a naval officer. Fig. 1 shows the body and cover, which are generally made of cast iron, but sometimes of composition, the basket of woven wire galvanized (but in small strainers, of tinned copper, with perforated holes), and the yoke and screw for securing the cover in place, as a perfect joint must be kept to prevent the breaking of the suction. The yoke may be constructed somewhat differently, but this type has fewer parts than any other. The strainer is always placed as near the pump as possible, so that, if there seems to be an insufficient water supply, the screw on the cover can be slacked as soon as the pump is stopped, the yoke swung back, the cover removed, and the basket taken out. If it has dirt in it, a spare one, which is kept hanging near, is inserted. The short time consumed, in contrast to that necessary to get down into the water at the intake end of the suction pipe, can easily be seen to be an advantage.

The handle of the basket should be high enough so that the boss on the under side of the cover will press it down in place. The body of the strainer can be arranged in a number of ways, as shown in Fig. 2, to suit the piping system. Type *A* has a high inlet and outlet; *B*, low inlet and high outlet; while *C* and *D* have low inlet and outlet. The clearing and drain plugs should be of composition, for if they were of the same material as the body the corrosion which would take place would prevent their being readily removed. The face of the cover should be painted, so that the gum joint will not stick when it is removed.

A. H. NOURSE.

The Technical Graduate from the Professor's Standpoint

I do not know whether it is safe for a school teacher to say anything in your columns or not. Of course, we are an impracticable lot, but that is only one of our troubles. Here is a sample of another kind: "This is only an approximate solution, but it is accurate enough for practical purposes. This problem, solved correctly, involves too much work to do at ordinary prices." This is a note appended to an alleged solution of a problem which I gave in the class the other day. As a matter of fact the error in the "approximation" was about 75 per cent., and just what the student's idea of ordinary prices was I do not know.

I try to impress on my students the fact that there are some things that should be done to the greatest degree of accuracy, and some in which an approximation is just the thing. I have been told that it is an unsafe thing. This proves it. It is for just such reasons as this that professors teach their students only those things on which they have positive information, or think they have. They do not dare to allow their students to realize that beyond the fixed knowledge there is a region of doubt and disagreement, and beyond that a region of blank space, so far as knowledge is concerned. I have no doubt that this is one reason why technical graduates have a hard time the first year or so. They graduate under the impression that they have been over the entire field of engineering, while as a matter of fact they have only nibbled a bit around the edges.

It takes lots of nerve for a college professor to get up before a class of boys, whose greatest delight is to "stick the prof." and tell them that there are a lot of things that he does not know.

THE VARIETY OF WORK THAT GRADUATES DO

Then another trouble: Here at this school we have been sending out boys for years, and we keep track of them. They are doing about as many different things as there are men. They have averaged to have three or four different jobs apiece since they graduated, mostly different. Some overlap, but I should say that we have to train these boys so that they can go at any one of a thousand jobs. Many of them are doing work that no teachers in the college ever saw done, and some are doing work of which their instructors never heard.

SOMEBODY ELSE SHOULD TRY

How can we train these boys so that they can walk in on a new job, hang up their coats, and take hold of the work, as if they were familiar with it? We ought to resign and let some of you people that know these things take our places. But you won't take them for the pay we get. More than that, you manufacturers who kick about the sort of men we send out won't chip in and give the schools money enough so that they can afford to pay better salaries. The only thing that we can do is to train these boys in the underlying principles of the things that you want them to do, and leave it to you to show them how to apply these principles to your business.

SUPERFLUOUS SUBJECTS OF STUDY

Probably we may send you a graduate who has studied 30 or 40 different subjects. In your work there are a dozen of these subjects of which you never heard. He tells you about what he studied and you tell him that we are a lot of dubs to fill him up with all that stuff instead of something practical. We send another young man to another shop. He finds the same thing. There are a dozen things that he need not have studied, but they are not the same things that your man did not need. If we send out men who are fitted for your work it means that every man, except the one you take, is more poorly fitted for the job he may take than he is now. We have trained the boys in physics so that they can, if necessary, make fine measurements. You set one of them to getting the length of a shaft where anything within an inch will do. He spends all the morning and tells you to a thousandth of an inch. He has just as good judgment about it as you would have on some job equally strange to you, and yet you say that we turn out a lot of half-baked idiots.

ORIGIN OF THE SWELLED HEAD

You say that we give them swelled heads. *We* don't, *you* do that. You come around and offer to take a whole class at wholesale. There are others. Each one of our graduates feels himself on the stand to be knocked down to the highest bidder. A fair percentage of them are good and will make good, and you know it. So you bid up. You are buying a pig in a poke, but you know you do not have to keep the pig if he does not fat up easily. So you take on four or five, if you want one, and you pay them more than you think they are worth, pick out the best one and drop the rest. The other four do not know you do not want them because they do not know enough to know that certain forms of lying are considered entirely Christian among some men. If they have swelled heads you give them the swelling. For all that I can see all must do the same thing that the big electrical companies do—take our graduates as they are, and then spend a year or two giving them an insight into their particular branch of the business. Of course, it would be cheaper for all of you, in one line, to chip in together and make it possible for some technical school to offer post-graduate courses to enable men to be trained just to suit your needs, but we know you will not do it because you are really pretty well satisfied as it is.

INSTRUCTOR.

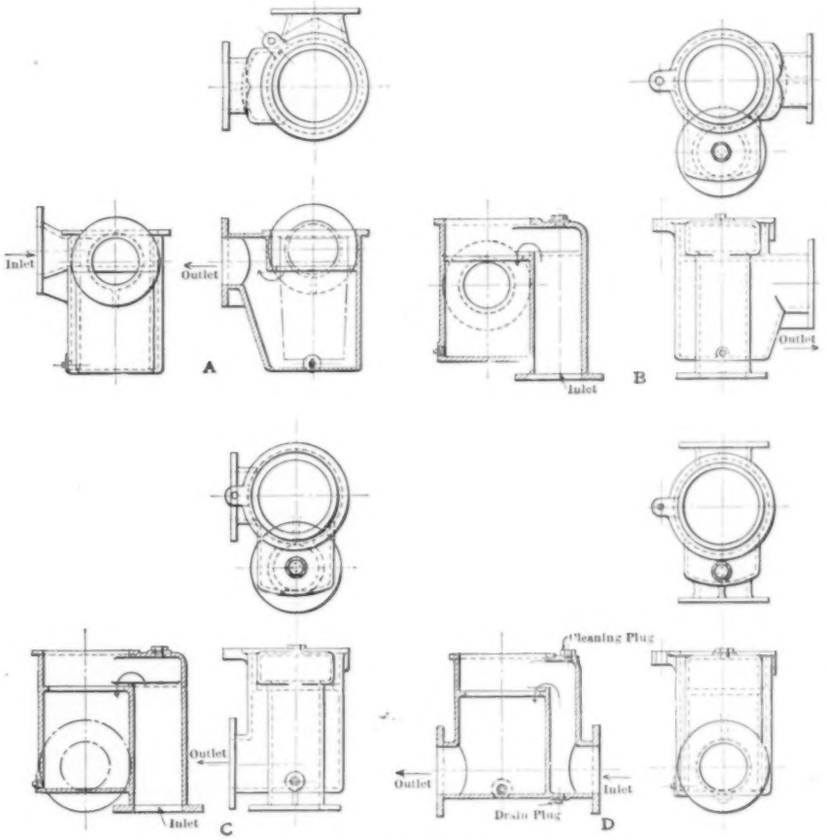


FIG. 2. SHOWING VARIOUS ARRANGEMENTS OF INLETS AND OUTLETS

The Manufacturing Shop for the Apprentice

It not infrequently occurs, that a young man contemplating an apprenticeship, is advised against enlisting his services with a large concern engaged in the manufacture of machines of standard design. As a rule, the chief objection raised is to the effect that the extensive use of jigs and fixtures, in a shop of this description, leaves little instructive work for the apprentice.

It is true that jigs and fixtures are used extensively, in shops of this kind, for in the successful manufacture of machinery on a large scale, they are indispensable. Nevertheless, it does not follow that there is no good work left for the apprentice boy, for in many shops, especially noted for this feature of up-to-date manufacture, will be found an equally good system of apprenticeship, which almost entirely excludes the use of either jigs or fixtures, these tools being manipulated by what is generally known as day-help. The term of apprenticeship is definitely divided into periods, variously devoted to lathe work, milling-machine practice, planer work, assembling and erecting machinery and, in not a few instances, to the building of jigs and fixtures, which is acknowledged to be the best work in the machinist's line.

There is also a splendid opportunity to study system as applied to manufacture, the importance of which cannot be too much emphasized, for it is lack of system

that is accountable in no small measure for the failures which from time to time occur in the industrial world.

The man who schools himself in systematic as well as in mechanical methods, is the best equipped to fill the high places in the machine building industry.

T. H. HANLEY.

Derivation of the Yard from the Meter.

There is a peculiar point in the relation between the standard meter and the standard yard that has an important bearing on the matter dealt with by Louis A. Fischer in his article describing the method of comparing standard measure bars, page 547.

DIFFERENCE IN YARDS

The point is that there is a difference between the legaiized equivalent for the meter in the United States and in England. The American adoption for the equivalent of a meter is 39.37 inches, as stated by Mr. Fischer, and I presume that this is legal in the United States. It is, however, only an approximation, as the actual length of the meter in inches is not exactly 39.37. The legal equivalent in England is 39.370113 inches (a difference of 0.000113 inch), and this is, I believe, nearer correct.

The difference will not seem much to the stone-mason, and the railroad machinist may not worry about it, but it is quite a serious matter to the gage maker, particularly in its relation to standards of reference. This error only goes to show the necessity for keeping the metric system and the English system distinctly separate, and I do not think the practice of comparing standards of length in English measure with metric standards is one to be encouraged.

There is only one metric standard, and that is the meter, and only one English standard, which is the yard. In referring one standard yard to another there is a possibility of error in measurement, as it will be admitted that it is impossible to obtain absolute accuracy; but comparing a yard with the metric standard permits of the possibility of at least two errors, since the yard cannot be compared with the meter, but with a fraction of it, i.e., 914.4018 mm., or thereabout.

Although it is possible to determine the value of the sub-divisions of the meter (or the yard) with an extremely small degree of error, the fact remains that 914.4018 mm. is not *the* metric basic standard, and, if 39.37 inches is not the correct equivalent, it follows that 0.9144018 of this is not a correct yard.

Of course, the errors on short lengths are very small, but as it is possible to detect a difference of 1/254,000 inch by comparison, it makes one wonder how confusion has not arisen in the comparisons of the sub-divisions of the yard with the sub-divisions of the meter on even small sizes.

NEW STANDARD BAR FOR THE YARD

I think the British method of bringing the reference standard up to date by making a new platinum-iridium yard will be by far the best in the long run, as the yard is the actual standard of the United States and England, and the two systems of measurement are so incompatible that the less they are mixed the better. The incompatibility is further increased by the fact that the metric standards should be measured at 0 degrees Centigrade, whereas English standards should be measured at 62 degrees Fahrenheit (16.67 degrees Centigrade). When the coefficients of expansion of the two standards being compared are known, their sizes at any temperature can be calculated, but calculations lead to figures that make approximations necessary, and possible error in determining the coefficient of expansion, and the difficulty of controlling temperature make this method of comparing undesirable when it could be so easily avoided by keeping the two systems distinctly separate.

VALUE OF EQUIVALENT CHANGED BY LAW

There is a point about the equivalent of a meter that is worth mentioning, although it does not affect the matter referred to above, but it will serve to show the undesirability of intermixing metric and English. The Weights and Measures Act of 1878 legalized the English equivalent for a meter at 39.37079 inches, and I believe the same equivalent maintained for some time in the United States, since it is quoted in "Standards of Length" by Mr. Bond, at practically the same figure. Twenty years after this date, however (May, 1898), an act was passed making the equivalent 39.370113 inches in Great Britain, and this maintains, and is, apparently, a closer equivalent than the American adoption of 39.37 inches.

An examination of 15 or 18 text books and tables of metric equivalents shows the fact that few of them contain a correct equivalent for a meter, and that the average table of equivalents is most unreliable when dealing with fine measurements. Only three text books out of the number examined gave the correct equivalent, although the bulk of them were of comparatively recent publication. In the case of one American text book, and an English pocket book, the publishers, evidently with a desire to strike a happy medium, gave the equivalent as 39.370432 inches. The jewel of the lot, however, was the statement that a meter equaled 3 feet, 3⅜ inches bare. Two meters, by the way, equaled 6 feet, 6 11/16 inches, 1/32 inch and 1/64 inch full.

J. E. STOREY.

Harrington, England.

The above letter from the expert of The Newall Engineering Company, whose interesting gages and measuring instruments have been described and illustrated in our columns, was submitted to Mr. Fischer, the Bureau of Standards expert, whose article is referred to. He replies as follows:

While the criticisms by Mr. Storey of the practice of deriving the yard from the meter may at first sight appear to be well taken, I am certain that the more thoroughly the matter is discussed and the reasons which prompted this action understood the more will the wisdom of this course be recognized and approved.

OUR YARD DEFINITE

The result of the action taken in 1893 has been to give the United States yard a definite length, whereas Great Britain finds itself fourteen years later without a reliable standard. In answering the criticisms of Mr. Storey, I shall claim the privilege of repeating some statements made in my former article.

The first and perhaps the most important claim made by Mr. Storey is that the value of the meter, 39.370113 inches, legalized in England is more nearly correct than the more convenient value 39.37 legalized in the United States. If it can be shown that the difference of 0.000113 inch between the legal equivalents in the two countries is less than the uncertainty in the comparison of two identical yards, or less than the variations in the length of the Imperial yard, then it would seem that the difference need not worry the gage makers any more than it does the railroad machinist or the stone mason.

A COMPARISON OF COMPARISONS

While there is other evidence that the value of the British Imperial Yard cannot be reproduced or maintained closer than the 0.00015 inch, the report of the last comparison of the Imperial yard (No. 1) and its three parliamentary copies (Nos. 2, 3 and 5) is sufficient to prove this claim. The comparisons referred to are described in the report of the superintendent of weights and measures, Standards Department, Board of Trade, 1903, and the results are given of four comparisons made between 1855 and 1902. In order than anyone may draw his own conclusion, the results of the comparisons are here given:

	1901-2. Inch.	1892. Inch.	1876. Inch.	1855. Inch.
P. C. No. 2 = No. 1	— 0.000024	+ 0.000006	+ 0.000036	+ 0.000024
P. C. No. 3 = No. 1	— 0.000096	+ 0.000055	+ 0.000057	— 0.000034
P. C. No. 5 = No. 1	— 0.000085	+ 0.000070	— 0.000033	— 0.000055

Considering the comparisons made in 1892 and 1901-2, the relation of the Imperial yard No. 1 and parliamentary copy

No. 3 changed from +0.000055 to —0.000096, a total of 0.000151 inch, while the relation between No. 1 and No. 5 changed from +0.000070 to —0.000085, or a total of 0.000155 inch.

All of the above bars were made at the same time and are of the same form and material, consequently there is no reason to suppose that the Imperial yard is less liable to changes than its copies. Indeed, so far as two comparisons considered throw any light on the question, they agree in indicating that the change was in the Imperial yard rather than in Nos. 3 and 5. I do not claim that this is the case, but merely that the Imperial yard cannot be reproduced closer than the 0.00015 part of an inch. If this is admitted, what becomes of Mr. Storey's claim that the British value of the meter in inches, which is 0.000113 inch larger than the United States value, is more nearly correct. I for one cannot see the use of legalizing a relation carried out to millionths of an inch when it is doubtful to the ten-thousandth part of an inch.

Mr. Storey also objects to the fact that the yard cannot be compared with the meter but only with a fraction of the meter.

COMPARISON OF THE YARD WITH A FRACTION OF THE METER

The dimensions of machines or gages are not usually a certain number of whole meters or yard, they are but fractions of these standards. Gages are usually a certain number of inches or parts of inches, or a certain number of millimeters, and we do not consider them inaccurate for this reason. The accuracy of the inch and the foot are not doubtful because they are derived from the yard, nor is that of the millimeter or the decimeter because they are fractions of the meter. Why, then, should a length equivalent to 0.9144018 meter, which we call a yard and which is a yard as closely as it is possible to define that standard, give the gage maker any concern? It is a perfectly definite part of the best fixed standard of length in the world and it can be measured with an accuracy many times greater than it is possible to obtain by reference to the present Imperial yard.

HOW SHALL ITS LENGTH BE DETERMINED?

Mr. Storey seems to think that the whole difficulty will be overcome if Great Britain adopts a platinum-iridium yard, but assuming that this course is to be pursued how is the length of the new standard to be determined? No human agency can guarantee to rule two lines on a bar that will be a yard apart at some definite temperature as closely as the 1/250000 part of an inch, this limit being named because the length of the United States yard is now fixed as closely as this in terms of the meter. The new yard would, therefore, in all probability, have a correction which might amount to more than the 0.0001 part of an inch if the experience of the International Committee on Weights and Measures be accepted as the criterion. Out of the thirty bars made under the supervision of this committee only one agreed with the original Meter des Archives so closely that the difference was within the probable error of comparison. The others were found to have corrections between 0.0003 and 0.0028 millimeter. As it is hardly probable that Great Britain will go to the expense of making a large number of platinum-iridium bars for the sake of securing one in practical agreement with the present Imperial yard, it will eventually be compelled to either ignore any slight differences found between the new yard and the Imperial yard *at the time of comparison*, or else to apply a correction to the new yard. I fail to see where either of these courses would be in any way more satisfactory than that adopted by the United States when it declared the yard to be $\frac{3600}{3937}$ meters.

To those like myself who are required to use both systems, the ratio adopted is easy to use and convenient to remember. Great Britain has a material interest in the international meter and is in possession of at least one authentic platinum-iridium copy of that standard. Under these circumstances and in view of what has been said about the impossibility of reproducing the Imperial yard, it would seem that Great Britain could not do better than follow the examples of this country and Japan, by fixing the new yard by reference to the International meter.

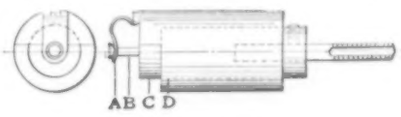
LOUIS A. FISCHER.

Washington, D. C.

A Tapping Chuck

Tapping small blind holes to their full depth with certainty is not among the best of jobs for the life of the tap, unless some automatic reversing or friction slip chuck is used. The lack of such an adjunct to our tapping machine caused the devising of the chuck described herewith.

The chuck was particularly made for tapping axial holes less than ⅛ inch diameter in the ends of 5/16-inch round Swedish-iron bell-bobbin cores, the work being fed up to the tap by the tail spindle with which the machine is provided. Referring to the sketch, the arrangement consists of a driving shell *D* bored to the depth shown by the dotted lines, an easy fit for the tap-chuck proper *C*. The solid portion of *D* is cut away, exposing a little more than half of the bore. The tap-chuck is also cut away at the back to form a tongue a little more than a semicircle in cross section. This tongue projects through the cut-away portion of *D*, thereby engaging positively with *D*. A headed steel pin *B* with a convex-faced washer is fixed to *C*, either by screwing or tight driving, through the spring *A*. As shown, the tap is fixed by a small grub screw. To use the chuck the shell *D* is gripped centrally in a chuck on the machine and the tap-chuck *C* is pulled out against the action of the spring *A*, being turned the while to cause the tongue on *C* to rest on the ledge formed on the bottom of *D*. The tap will then be set to the full extent of its travel, any longer movement being made possible by the travel of the tail spindle. By slightly turning *C* until its tongue corresponds to the opening in *D*, the spring pulling on *C* will pull it back. It will be plainly seen that if the machine be set in motion and the work fed up, the tap will be kept back until the work stops feeding, when *C* will be drawn out until it is completely in



A TAPPING CHUCK

the bore of *D*, and the tap will cease to rotate. The machine should then be reversed and the work pushed forward slightly to cause the spring to pull *C* into engagement with *D*. A necessary precaution is to hold the work back tightly to prevent it running up on the tap. The chuck is made of hardened steel throughout.

W. MADDISON.

London, England.

The French Minister of Public Instruction has decided that all teachers throughout France are in future to employ the following distinctive abbreviations for the various weights and measures: For denoting length—myriametre, Mm; kilometre, Km; hectometre, Hm; decametre, dam; metre, m; decimetre, dm; centimetre, cm, and millimetre, mm. For areas—hectare, ha; are, a, and centiare, ca or m^2. For measures of bulk (timber), decastere, das; stere, s or m^3, and decistere, ds. For measures of mass and weight—tonne, t; quintal metrique, q; kilogramme, kg; hectogramme, hg; decagramme, dag; gramme, g; decigramme, dg; centigramme, cg, and milligramme, mg. For measures of capacity—kilolitre, kl; hectolitre, hl; decalitre, dal; litre, l; decilitre, dl; centilitre, cl, and millilitre, ml. The use of the capital letters for the three largest denominations of length are intended to prevent confusion, and all the other abbreviations follow on uniform lines. The employment of full stops between the letters is officially abolished, and k.g. for kilogramme and m.m. for millimetre disappear.

When a mere man on a simple, silent 20-pound bicycle is able to pedal more than 59 miles in 60 minutes and better than 105 miles in two hours, the world-wide clatter created by the performances of the big, thundering 100-horse-power monsters that compete in Vanderbilt cup races and like events, seems gross exaggeration, indeed.—*Bicycling World.*

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications of the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1906 *the* AMERICAN MACHINIST *printed and circulated* 1,083,205 *copies, an average of* 20,832 *per issue. Of this issue* 19,500 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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What is a Yard?

It is generally supposed that the British yard and that used in America are identical. They are so for all practical purposes, but there is nevertheless a difference which, some day, may possibly become a matter of some importance, unless it is adjusted.

The facts seem to be that the actual length of the British imperial yard is not known nor determinable within about 0.00015 inch. Ours is known within a much smaller limit, simply because it is defined as a definite fraction of the best known fixed standard of length.

It has been and is being constantly declared that measurements in the English system cannot be derived from measurements in the metric; that the two systems are incommensurable. This is believed by some to be true, even with such ordinary measurements as are made in machine construction. As a result of the statement that our standard yard is derived from, and is expressed as a certain fraction of, a platinum-iridium bar one meter long, made at the International Bureau of Standards, much indignation has been expressed; also the conviction that such a thing was impossible. We were urged, nay, challenged, to arrange for the publication of an article showing just how such a thing was done. At page 547, Part 2, of Vol. 29, we published an article by Louis A. Fischer, giving in detail and illustrating the methods followed in doing such work in our Bureau of Standards, at Washington.

No criticism of these methods nor any opinion expressing doubt as to the accuracy secured by them has come to our notice. We have, however, a communication from an English expert in such matters, which we publish in another part of this issue, and with it Mr. Fischer's answer.

The facts to be derived from these two communications are very interesting to all who have to do with close or refined measuring.

In view of the facts set forth in the British official records quoted by Mr. Fischer, the answer to the question of how the British authorities shall go about defining and fixing the length of the new and modern standard yard bar, which they contemplate making, is not so simple as it looks at the first glance.

The man in the street would say: "Just make it the same length as the present bronze bar." But what is that length, and how is it to be determined? An obvious way would be to make a large number of careful determinations of its length, and call the average of them the true length. These different observations would probably differ from each other by as much as 0.00015 inch; due mainly to inherent deficiencies and uncertainties in the bar itself. While this error, which in an inch would amount to only about four millionths of an inch, is small, and with our present stage of refinement in measuring will be far from discoverable in any constructive work, it would yet seem to be very desirable in every way that the yard of Great Britain and our own yard should be as nearly alike as the most refined methods of mensuration can make them.

Not alone in Mr. Fischer's opinion, but in the opinions of others, well qualified to speak upon the subject there is no way better than, nor any as good as, to define the British imperial yard as a certain fraction of the length of the metric standard bar, and then to make a new yard bar by comparison with the metric standard.

If this be true, then it would seem to be the dictate of common sense to fix the relation between the British yard and the meter at the same value established by ourselves and accepted by Japan, after careful examination. The difference in results will not be noticeable so long as the present bronze, steel and other relatively crude standards of length are considered; but it will be discoverable when modern, scientifically constructed bars are compared with each other. In other words, whether Great Britain finally adopts 39.370113 inches as the British equivalent for the length of the meter, or our own simpler and more convenient 39.37 inches, will make no difference that any machine constructor will be able to discover; and none that any bureau of standards man can discover until he comes to compare two modern, scientifically made platinum-iridium bars.

It seems a pity that a difference between the Imperial and the United States yard should exist for such an intangible and unimportant reason, and we venture to hope that if Great Britain makes a new standard yard bar, it will be the same as the yard we derive from the standard of the International Bureau of Weights and Measures—to the end that there may be the closest possible agreement between the two principal nations that adhere to the yard in their answer to the question which forms the title of this article.

As to Guarantees of Production with Machine Tools

A short time ago we printed an article, in which the unreasonableness of the buyer of a certain machine tool was set forth; said unreasonableness being based upon his action in declining to accept gracefully a machine tool which did upon trial only 3¼ times the amount of work the buyer had been doing previously, whereas the builder of the new tool had agreed that it would do four times as much as he had been doing. The builder of the tool in this case considered that the buyer was unreasonable, and that he ought to be entirely satisfied with a new machine that would do more than three

times the work he had been doing previously.

This raises an interesting question. It is probably true that in most cases a man who buys a new machine ought to be well satisfied if it does three times what the older machine has been doing. Nevertheless a contract is a contract, and when it is made both parties to it may base other arrangements upon this contract, and depend upon its being fully and completely carried out. Suppose, for instance, that the buyer of a new machine is considering the purchase of several different machines, or is planning several alternative ways of doing a certain line of manufacturing work within his establishment. He comes to a decision, after careful study, as to which is the best machine to put in, basing this decision not only upon first cost of the various machines or installations investigated, but also upon their prospective durability, and the rate at which they can be made to produce work. Having decided what installation to make, it may be important to him that each machine or individual element of the installation shall do what it is guaranteed or contracted to do, and he may make contracts to furnish work based upon such a guaranteed performance by each of the elements composing his installation. In such a case is he really unreasonable if he objects when a machine, guaranteed to do four times the work that his old one had been doing, proves upon trial to do only 3¼ times as much?

Is it not better on the whole that, unless the builder of a machine tool is absolutely certain as to the amount of work that can be done, he should make his guarantee or his promise always a little, or perhaps considerably, below what he knows that he can do? If after making this allowance the offer which he can make the prospective buyer is not sufficiently attractive to bring business, then possibly it is better to lose the business than to undertake it with any chance that it may turn out unfavorably and unpleasantly. We know of concerns who, after making the most careful investigation and calculations as to what their machine will do in a given position, always guarantee materially less. The customer, instead of being disappointed, is happily surprised, and the plan works well.

If a buyer of broadcloth strikes a bargain and contracts for enough to make a suit of clothes, ought he to be satisfied with the delivery of three-fourths of enough, because it is good cloth for the money?

Supervision of Railroads

James J. Hill, an undoubted authority on railroad matters, and a man of very great ability, has been telling the people of the country how much money needs to be spent annually in increasing the capacity of our railroads. It is a prodigious amount, more, in fact, than some other authorities believe to be necessary; but whether it is or not, Mr. Hill warns us that the money will not be obtainable unless the general public ceases its agitation for a greater participation in the management of what really constitute the modern highways of the nation. Right or wrong, however, it is probably safe to say that agitation will not cease, but will go on. The people of the country generally, not merely agitators, but business men, farmers, and other conservative citizens throughout the country, have become convinced that the interests of the public have not been, and are not being, sufficiently looked after in connection with our railways; and it is morally certain that the agitation for a greater control and supervision of these roads will go on until such greater control and supervision are secured.

In this connection it is interesting to observe that such a conservative paper as the *Times*, of London, in commenting upon the American railroad situation, recently said: "The whole interests of the shareholders, even in the largest lines, are mere gambling counters in the hands of possessors of enormous wealth amassed by downright plunder. There is certainly need on all grounds for a thorough investigation and for the thoroughgoing reforms President Roosevelt has set himself to carry out."

Transplanted Industries

Of course the end of the story of the establishment of the British Westinghouse Company has not yet been reached, but it is interesting to note that at the present stage of the proceedings it is the turn of our British cousins to draw morals from the experience. There is no denying that things have not gone with the company as they were expected to go. In the competition for trade, it has not had things entirely its own way. It has been discovered that there are a good many things pertaining to the general and the particular industrial situation in Great Britain which must be thoroughly learned before one can hope to conduct manufacturing operations there with a fair prospect of success; that the methods of American shops cannot be taken bodily and transplanted to England. It might possibly be done if one could take with him not only his officials, managers, and men for responsible positions, but also the entire force of workmen, and if he could then hold them there. Obviously it is not practicable to do this; in other words, any attempt to establish an industry there by Americans must in the nature of the case be more or less of an attempt at mixing the two systems, and as things now stand, the British competitors of the Westinghouse British Company consider themselves entitled to do a little crowing and are doing it.

A London financial paper, commenting upon a recent report by the company, remarks: "Here we have a pretty complete admission that the attempt to Americanize English industrial methods in too drastic a manner and without due regard to native environment has failed. When you go to Rome, you must do as the Romans do, and when you start business in the United Kingdom, you must conform to the fashions of Englishmen. Factories that can cope with the volume of work generated by a country as big and as extensively populated as the States are out of place in an island like our own already admirably served and with the bulk of its electric trade beyond its borders."

No doubt the company named will in the end overcome all obstacles, but in the meantime other Americans and in fact manufacturers everywhere ought to profit by its experience.

The Telephone in New York City

The telephone business in New York City has become a pretty big thing. This city has more telephones than London and the ten other large cities of Great Britain combined; it has not only more than Paris, but more than all the telephones in France, Belgium, Holland and Switzerland combined; and more than are to be found in the twenty largest cities in Germany. The number of telephones in service and under contract in the combined territories of The New York Telephone Company and The New York & New Jersey Telephone Company is 389,000; there are 182 central offices and the total number of employees is 17,000. The New York Telephone Directory is a book of 738 pages, weighs three pounds, and one edition of it fills a train of 25 freight cars. The book is revised and redistributed every four months.

When the buildings that constitute modern New York are under construction, telephones are regularly installed by means of which men employed in various parts of the structure communicate with each other; and mortar and other building materials are now regularly ordered up by telephone.

General Murray, speaking on the occasion of the visit of the American Society of Mechanical Engineers to Sandy Hook and comparing the older installation of disappearing guns, those mounted on platforms arranged to be hoisted and lowered by hydraulic power, with those mounted on the modern disappearing carriage, said that whereas the two guns with the first named arrangement cost about $700,000 and could fire one shot in five minutes, the latter had cost about $300,000 only, and could fire a shot every 50 seconds.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A BENDING MACHINE

Fig. 1 shows a machine for bending metal to various shapes, and Fig. 2 shows

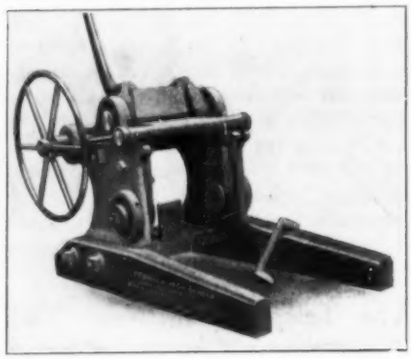


FIG. 1. A BENDING MACHINE

a few of the shapes bent on this machine. The machine is hand operated, and will bend iron up to 1½ inches thick by 12 inches wide. Light iron can be bent cold while the larger sizes must be heated.

At the top of the machine is the operating lever, five feet long. This fits into a recess in the moving die, and is readily removed if desired. The motion of this lever, in operation, is downward. The approximately vertical face between the housings is the upper or moving die; immediately in front of this is the fixed die. It is fixed at the time the bend is made,

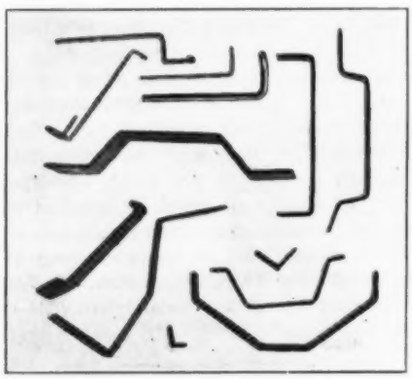


FIG. 2. SOME OF THE SHAPES BENT ON THE MACHINE

but is adjustable in a horizontal plane by means of the hand wheel. The shaft of the hand wheel has two eccentrics, which actuate the lower die through connecting rods, one of which is shown in the illustration. This motion is used when clamping the material between the dies. The lower die is also vertically adjustable by means of two eccentrics on the sides of the machine and immediately beneath the die. Various angle blocks are required for certain work, one of which is shown lying against the skid to the right. When material is to be bent it is inserted vertically between the two dies, the material is clamped by turning the hand wheel and the hand lever is pulled down. This brings the upper die in contact with the material, and draws it down to the lower die or the angle block, should it be necessary to use one.

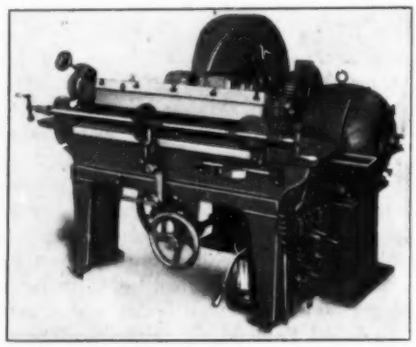
The machine is 25 inches wide, 23½ inches high, 4 feet 3 inches long, including the skids, and weighs 800 pounds.

It is built by the American Road Machine Company, Kennet Square, Penn.

A MOTOR-DRIVEN KNIFE GRINDER

The illustration shows a machine for grinding planer, paper-cutter and similar knives. The cross feed is automatic and can be set to stop feeding at any point. The work is flooded with water. The knife bar to which the blades are secured can be swiveled so as to make the emery wheel cut the same on each end of the traverse. A graduated dial at the end of the knife bar insures the knife being set to the desired bevel. By releasing the friction in the center of the large hand-wheel, the carriage can be traversed by hand. The emery wheel is set on an extension with a box leg and is so arranged that the wheel can be set forward when worn.

The motor is mounted on a bracket attached to the side of the machine and

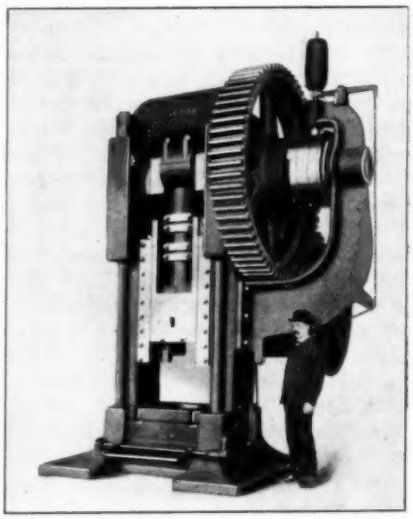


A MOTOR-DRIVEN KNIFE GRINDER

supported on a base reaching to the floor. The emery wheel is driven through gearing in such a manner that when it becomes necessary, through wear, to shift it forward it is not necessary to shift the motor. The machine takes an emery wheel 26 inches diameter by 1½ inches face, with a 12-inch hole. The spindle is 1½ inches diameter and has self-oiling bearings 7 inches long. These machines are built in four sizes, from 32 to 62 inches capacity, with either belt or motor drive, by the Bridgeport Safety Emery Wheel Company, Inc., Bridgeport, Conn.

A LARGE PRESS

The illustration shows a large press for making stampings of the class illustrated in Figs. 2 and 3. Both of these stampings are made of steel plate. The press, as will be seen, has a single pitman. The



A LARGE PRESS

frame of the press is of cast iron in one piece, and weighs 42,800 pounds. The capacity of the press is 12,000 tons pressure; distance from the bed to the slide with the slide and adjustment both up, 31 inches; diameter of crankshaft at crank bearing, 13 inches; stroke, 14 inches; ratio of gearing, 40 to 1. The large gear is 92 inches diameter by 14 inches face, and weighs 9000 pounds. The fly-wheel is 60 inches diameter and weighs 2400 pounds. The adjustment of the slide is 6 inches;

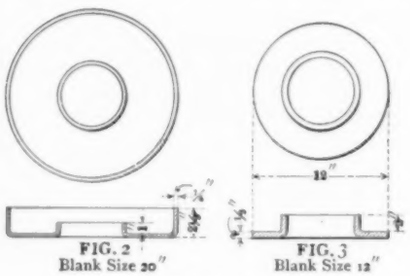


FIG. 2
Blank Size 20"

FIG. 3
Blank Size 12"

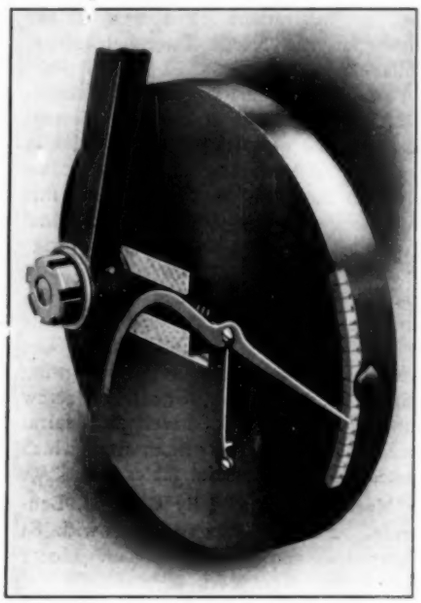
TWO STAMPINGS DONE ON THE PRESS

hight over all, 14 feet 8 inches. The bed is 37x37 inches. The machine weighs 100,000 pounds, and is made by the Toledo Machine and Tool Company, Toledo, Ohio.

A STROKE INDICATOR

The illustration shows a stroke indicator for indicating the stroke of slotting machines, which, as a general thing, is set by guess. The device is so simple as to require very little explanation. The periphery of the crank disk is graduated for a certain distance. A sheet-steel pointer is

pivoted as shown. One end of the pointer is straight and reaches to the graduated part of the periphery of the crank disk. The other end is curved and bears against the shoulder of the stud, being kept in contact with it by a light spring. Any movement of the stud to or from the center imparts a movement to the pointer,



A STROKE INDICATOR

which indicates on the graduated edge the stroke to which the slotter is set. The curve referred to permits equally spaced graduations. This device is made by the T. C. Dill Machine Company, Inc., Philadelphia, Penn.

A NEW COMPASS AND DIVIDER

We illustrate herewith a combination compass and divider which is being made by the International Electrical Manufac-

NEW COMPASS AND DIVIDER

turing Company of 19 East Fifteenth street, New York. It is stamped up from sheet metal and carries pen, pencil and spacing points. When closed, the pen and pencil leg folds into the main leg, making it convenient for carrying in the pocket, for which purpose a leather case is provided. The instrument is not of draftsman's grade, but for school and desk use it should prove very useful.

TURRET CHASING TOOL

The illustrations show a chasing tool built by the Jones & Lamson Machine Company, Springfield, Vermont, for use on their flat-turret lathe. This device cuts screws of any size from the 12- or 14-inch swing of the machine down to

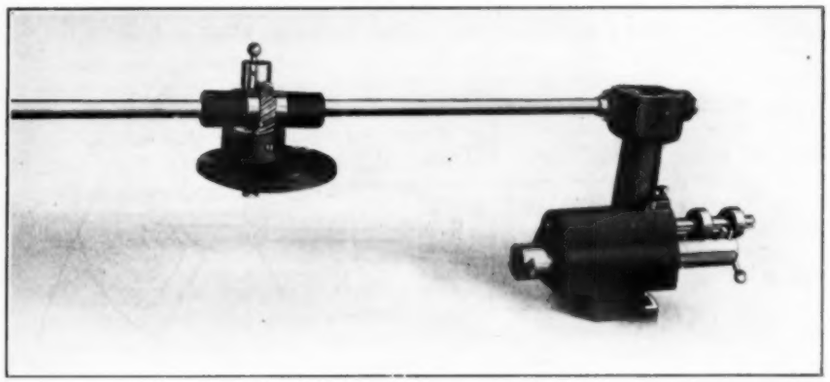


FIG. 1. TURRET CHASING TOOL

2¼ inches diameter for internal work, and one inch for external threads, and cuts any length under four inches. Fig. 1 represents the tool ready to be attached to the machine; Fig. 2 shows it in place on the turret, though not swung round to

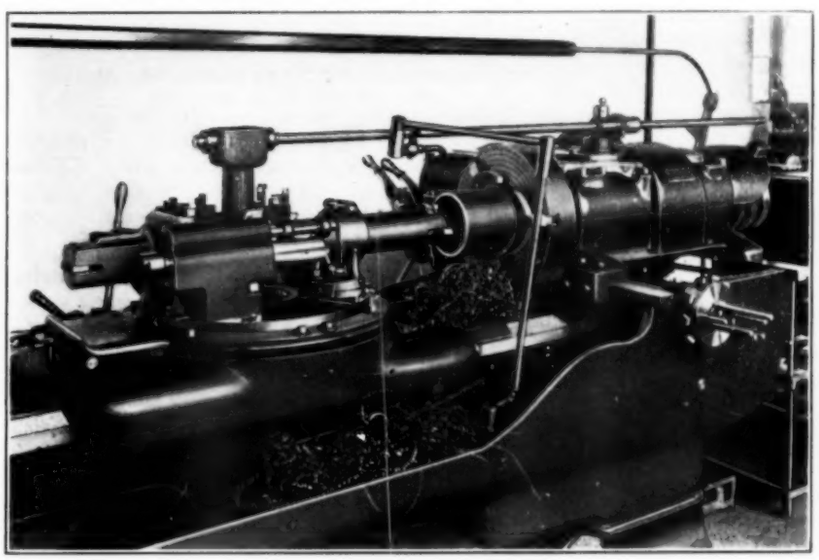


FIG. 2. CHASING TOOL ATTACHED TO TURRET

working position; Fig. 3 shows the general construction and the mechanism for actuating the cutter bar. In use the bar carries the chaser back and forth over the work automatically, while the operator merely regulates the depth of the cut by feeding the cross-sliding head the required distance at each pass of the tool. The cutter bar is actuated by the short lead-screw shown, an extra screw and nut being required for each lead.

The operation of the tool is very simple. The turret carriage is brought forward until the main casting *A* of the chasing tool comes as close to the work as convenient; then the carriage is clamped while the cutter is operated by its mechanism, which receives its motion from the main spindle through bevel and spiral gears and overhead rod. The sliding bar *B*, which carries the cutter *C*, also carries a segment of a nut *D*, which is thrown in and out of contact with the small lead-screw *E* by the rod *F*. This rod has a cam surface directly under the nut *D*, so that its partial rotation causes the nut to go into the thread or drop back out of it. This same rotation causes the cutter to travel back and forth by the action of the crank-pin *G*. Rod *B* may be actuated by the handle *H* or by collars *I* and *J*, which are provided with face pins, which may be alternately driven down against the rod *F* to cause its partial rotation. The collars are set according to the length of the thread. The quick return of the cut-

ter bar is effected by gear *K*, which is driven by a spring friction and has a retarding effect on the cutter as it advances; and the instant the nut is withdrawn, this gear *K* has sufficient force to withdraw the cutter bar quickly. The bar comes back until pin *L* strikes collar *J* and rests with the pin against the face of the collar until the pin in this collar comes around and pushes *L* down again. The forward motion of the cutter is arrested automatically by collar *I* striking the pin *M*.

The cutter may be of the chaser form or a single-edge cutter, according to the character of the work; but if of the chaser form, it must have ample clearance so as not to affect the natural lead of the screw. Right- and left-hand threads are cut by simply reversing the swivel head *N*, so that the horizontal bevel gear comes on the opposite side of the bevel gear on the vertical shaft.

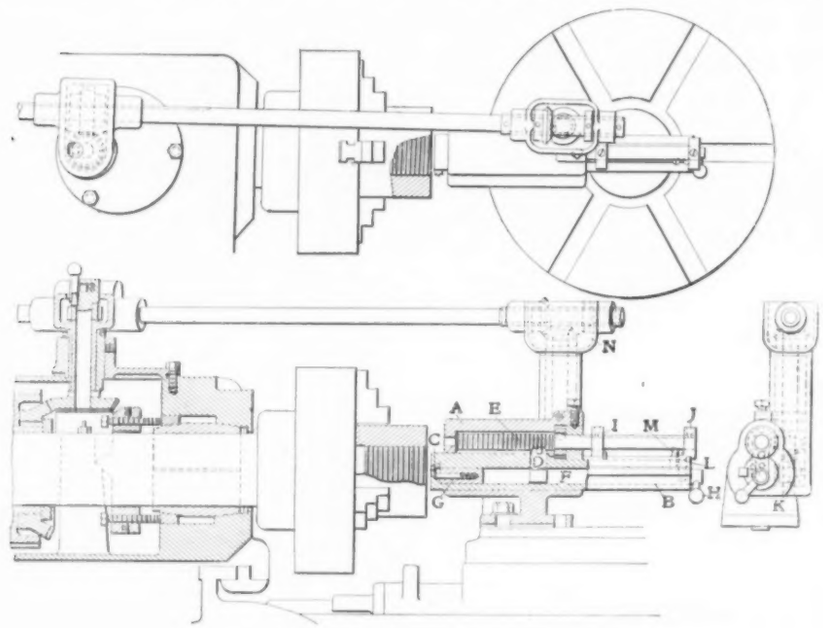
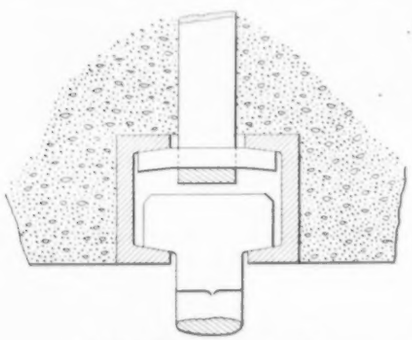


FIG. 3. SHOWING CONSTRUCTION OF CHASING TOOL

THE ATTACHMENT OF SHAFT HANGERS TO CONCRETE BUILDINGS

Referring to our article on this subject at page 697, James A. Brown, of 820 Corinthian avenue, Philadelphia, calls our attention to a patented construction of his for accomplishing this object. Referring to the illustration, it will be seen to consist of two small channels or grooved steel pieces, supported by a continuous plate or at intervals by small plates and stirrups. For pipe and wire supports the small ⅞-inch channel used for plaster partition work is very convenient.



A SHAFT-HANGER SUPPORT

New Publications

"Tests of Concrete, I Shear; II Bond." By A. N. Talbot. 34 6x9-inch pages with 10 illustrations and 25 tables. The University of Illinois, Urbana, Illinois.

This pamphlet, which is Bulletin No. 8 of the University of Illinois Experiment Station, gives the results of a large number of tests of concrete under different stresses. The tables are very complete and the data are of fundamental importance to the constructor in concrete.

"The Elastic Arch, with Special Reference to the Re-enforced Concrete Arch." By Perkins R. Leffler. Fifty-seven 5x7½-inch pages, with five folding plates. Henry Holt & Co., New York.

The elastic arch is well known as a difficult subject, and this manual is an attempt to simplify its theory as evolved by Profs. H. P. Eddy and William Cain. The author is a man of experience in this class of work, and in the rapidly growing use of reinforced-concrete construction his book will no doubt be widely read.

"A Course of Study in the Machine Shop." By H. E. Thomas. 43 5½x8-inch pages. The Tuskegee Institute, Tuskegee, Ala.

These pamphlets, of which there are two—one devoted to the first and the other to the second year's work of students in the Tuskegee Institute—give an outline of the regular work of the students in the machine shops of that institution, together with remarks on the nature and capacity of the various tools and various hints and cautions for their use. The whole is very creditable and indicates careful thought in the schedule of work and equal care in its execution. The pamphlets are printed by students of the institute.

"Mathematics for the Machine Shop." By Frank Piers. 78 3½x5½-inch pages, with 33 illustrations. Published by the author at 223 North Twentieth street, Philadelphia. Price, $1.

The author of this volume has given in compact form a good deal of information intended especially for mechanics in the shop. After discussing arithmetic, he takes up mensuration and follows this with some of the more useful geometrical problems. Following this he takes up trigonometry and shows how to solve a good many problems which are of common occurrence in the shop by means of the customary tables of sines, cosines, etc. The setting of milling machines for cutting spirals, the calculation of gears for screw cutting, and of spur, bevel and spiral gears, then receives attention, after which comes a series of useful tables.

"Machine Design." By Chas. H. Benjamin. 202 5x7½-inch pages, with 84 illustrations and numerous tables. Henry Holt & Co., New York.

This book has been prepared primarily as a manual of instruction for the students of the Case School of Applied Science. It covers the usual subjects discussed in such books, together with some, such as ball and roller bearings, which are only beginning to receive attention in books of this character. It is well known that Professor Benjamin has been very active in experimenting in various fields at the Case School, and the results of these experiments are here embodied in form for practical use. The experiments relate to the strength of cast-iron cylinders, pipe-fittings, helical springs, roller bearings, gear teeth, pulley-arms, and the bursting strength of fly-wheels, the last especially being unique and of very large importance.

"A Pocket Book of Mechanical Engineering." By Chas. M. Sames. 195 4x6½-inch pages, with 41 illustrations. Second edition. Published by the author, Jersey City, New Jersey. Price, $2.

The fact that the first edition of Mr. Sames' pocket book has been exhausted in a little more than a year indicates plainly enough that it has met with appreciation. The special feature of the book lies in the fact that the usual plan of including a series of condensed treatises on the various subjects discussed is abandoned, the user of the book being assumed to have an acquaintance with general principles and to need only those facts and data which cannot be carried in the mind. The book is consequently extremely compact and small as compared with other pocket books, although

the ground covered is not less comprehensive. As regards machine design, in fact, it contains much more than most of the other pocket books.

"A Text Book on Hydraulics, Including an Outline of the Theory of Turbines." By L. M. Hoskins. 271 6x9-inch pages, with 127 illustrations. Henry Holt & Co., New York.

This book is intended for the use of the students of Leland Stanford, Jr., University, where its author is professor of applied mathematics. The author regards Bernoulli's theorem as the key to a correct understanding of all problems in the steady flow of liquids, and the book is based to a very large extent on that fundamental principle. In connection with the presentation of working rules for estimating flow in the various practical cases met by the engineer, it has been pointed out to what extent theory is defective and the resulting formula therefore empirical. There is also no pretense of precise knowledge when real knowledge is imperfect, the author stating that he has failed to convince himself of the reliability of many existing tables based on the opposite assumption. The discussion of the principles of turbines is quite full, due attention being paid to the American form of impulse turbine.

"Air Compressors and Blowing Engines." By Chas. H. Innes. 290 5x7-inch pages with 285 illustrations. The Technical Publishing Company, Limited, Manchester and London; the D. Van Nostrand Company, New York. Price 4 shillings, 6 pence; $2.

The first chapter of this book on the physical properties of air develops the customary formulas for finding the power required to compress a given amount of air in simple and compound compressors and the second discusses the loss of power due to friction of air in pipes, while the third gives the results of experiments on air compressors. The remaining and much the larger portion of the book is chiefly descriptive and shows in large variety, the practice of various builders of blowing engines and air compressors. Most of the machines shown are of European make and should on that account be all the more acceptable to American engineers, as some features of advanced practice in this field of work have undoubtedly received more attention in Europe than here, many of the features shown being, in fact, almost unknown in this country.

"Electrical Wiring and Construction Tables." By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Co., 1907. 119 pages, 4¼x6 inches; bound in full Persian morocco, round corners, red edges. Price, $1.50.

This is a book which, while in size and shape literally a pocketbook, contains numerous data in such form that the desired figures can be quickly found. Thus, there are numerous tables for direct and alternating currents from which the amount of current for various amounts of horse-power, efficiencies, potentials, frequencies and power factors can be readily ascertained, as well as the sizes of wires necessary to carry these currents for given amounts of drop; also other tables by which the smallest wire to carry any given horse-power or number of lights under the National Electrical code can be at once picked out; tables for calculating the most economical loss; tables and diagrams showing the proper size of conduits to accommodate various numbers of wires; and tables for estimating quantity of material. The National Electrical Contractors' Association standard of symbols for wiring plants, and many other tables which the man in charge of wiring needs to have, are given. At the same time the book is not padded with useless matter.

"The Steel Square as a Calculating Machine." By Albert Fair, 81 5x7-inch pages fully illustrated. The Industrial Publication Company, New York, price 50 cents.

"The Steel Square Pocket Book." By Dwight L. Stoddard. 159 3¼x5-inch pages with 150 illustrations. The Industrial Publication Company, New York, price 50 cents.

These two books are sent to us at the the same time, and hence we notice them together. While both treat of the steel square, they do not cover the same ground, the former being devoted chiefly to calculations such as mechanics and especially carpenters have to make, and the latter to the layout of building frames, although this distinction is not an absolute one. Both are admirable in every way, Mr. Fair's book especially giving the impression of being written by a man who knows a lot, but who is content to tell a little, and that little just what his readers need. Many readers who are well educated in geometry will be surprised at the number of problems which he solves offhand with the common carpenter's square. While Mr. Stoddard's book devotes some attention to calculations of this kind, the bulk of it is made up of illustrations and explanations of the laying out of braces, rafters, jack rafters, stairs, polygonal roofs, etc. No carpenter can make a mistake by buying both books, and he would find it a difficult matter to choose between them.

"The Walschaert Locomotive Valve Gear." By W. W. Wood. 193 5x7-inch pages, with 37 illustrations and four folded plates. The Norman W. Henley Company, New York. Price, $1.50.

The rapidly increasing use of the Walschaert valve gear on the locomotives of this country makes a book on it very timely, and such a book the present author has supplied. He begins with an historical sketch of the origin of the gear, from which it appears that it was contemporaneous with the so called Stephenson link and was an independent invention intended, like that link, to overcome the difficulties of the old hook motion. The gear has been in continual use on the Belgian railway locomotives since its first invention, and on the locomotives of other European countries nearly as long. It is one of the anomalies which attend some important inventions that, after having ignored or condemned the gear all these years, American railroad men are now fairly falling over one another in their adoption of it and in sounding its praises. Mr. Wood is an enthusiastic advocate of the gear, and a good deal of his book is given to arguments in its favor. The critical analysis of the action of the gear is carried out in an excellent manner by the use of folded plates of diagrams, showing the locations of the crank, eccentric and link in various positions, and cardboard models of the valve which may readily be applied to the various locations, and the action of the valve upon the ports may be easily followed. The book will no doubt meet with the large sale which it deserves.

"Boiler Waters, Scale, Corrosion, Foaming." By William Wallace Christie, Member A. S. M. E. Consulting Engineer. New York: D. Van Nostrand Company, 1906. 235 pages, 6x9 inches, 77 illustrations; cloth; price, $3.

This is a thoroughly American book on the subject, abounding with examples from American practice, analyses of American waters, and illustrations of American apparatus; and is printed in good type on heavy coated paper, which causes the halftone illustrations of boiler scale, corrosion, etc., to show up well. It naturally starts with the properties of water and the common impurities in it, and gives practical instructions for determining the presence and character of the latter, some methods for analysis and determination of hardness, and also a large number of analyses of samples of water from all over the country. The presentation of actual examples is in fact noticeable throughout the book. The troubles caused by water and their remedies get a full treatment, the matter being first summarized in a table; and then the causes and effects of scale, corrosion and priming are fully discussed; Professor Sweet's mud-catcher is shown, and the subject of oil in boilers is discussed. After a chapter in which many American feed-water heaters are illustrated and described, the longest chapter in the book, on water softening, gives the chemistry of the matter briefly, and numerous examples from practice with statements of quantities of reagents, results, costs, etc.; and the principal American water-softening apparatus are illustrated and described. Some of the tables in the back of the book, such as the properties of saturated steam, are readily accessible elsewhere. The last one, however, is a

good thing to have in a book of this nature, which is likely to fall into the hands of many having but a slight knowledge of chemistry—the more so in view of the use throughout the book of chemical formulas; in this table there is a long list of substances with their chemical formulas, which of course show their exact composition. We think, however, that the usefulness of such a table would be much enhanced if both the common names and the precise scientific names were always given. We find opposite "alcohol" is given the formula for ethyl alcohol, and it is not unlikely that many will conclude from this that wood or methyl alcohol has the same formula.

Personal

Thos. Farmer, of Detroit, Mich., has accepted a position with the Warner & Swasey Company, Cleveland, Ohio, as their western representative.

W. S. Howe has resigned his position as advertising manager with the S. A. Woods Machine Company, Boston, Mass., and has accepted a position with the Canadian Fairbanks Company, Ltd., Montreal.

Perry West, recently connected with the New York Edison Company, is now at the head of the power plant department of W. S. Barstow & Co., of New York, and Portland, Ore. Associated with him are Carl F. Schreiber, of New York City, and Rulof Klein, of Cleveland, O.

H. F. J. Porter, 1 Madison avenue, New York, informs us that the consulting industrial engineering office opened by him about a year ago has broadened its scope considerably since its inception, and that he has now associated with him a number of engineers competent to deal with almost any of the problems pertaining to industrial management.

Obituary

William W. Murray, superintendent of the department of manual training in the Mechanics Institute, Rochester, N. Y., died recently at Norfolk, Va.

Willard L. Bundy, manufacturer of time registers, died at his home in Syracuse, N. Y., January 19. He was 61 years old. He was the inventor of the first time recorder and was in business in Binghamton before going to Syracuse.

Joshua Stevens, inventor of the Stevens rifle, died at Meriden, Conn., January 21, aged 92 years. He was born in Chester, Massachusetts. In 1896 he resigned as president of the Stevens Arms and Tool Company and removed to Meriden.

Business Items

The Independent Pneumatic Tool Company, Chicago, informs us that the sales of its "Thor" pneumatic and appliances during 1906 showed an increase of 50 per cent. over 1905, and that it is now several months behind on orders.

Crocker-Wheeler Company report numerous recent sales of their motors and generators, many of them to old customers who have had experience in testing their apparatus. They also report that their new rolling mill motor is meeting with much success.

The Wilmarth & Morman Company, Grand Rapids, Mich., reports that its December shipment of New Yankee drill grinders and Nelson loose pulleys exceeded by nearly 50 per cent. the largest December shipments of any preceding year in the company's history.

Niles-Bement-Pond Company, New York, have appointed Harron, Rickard & McCone, 436 Market street, San Francisco, Cal., agents for their entire line of machine tools, steam hammers, hydraulic machinery and electric traveling cranes for California, Nevada and Arizona.

The Coffeyville Foundry and Machine Company has been organized with a capital of $50,000, and is building a 50x100 machine shop and a 60x100 foundry building to carry on a general foundry and machine business. F. O. Weis is president, and T. C. Ferguson, manager.

The P. A. Geier Company, Cleveland, O., builders of special machinery, announce the purchase of a site at the corner of St. Clair avenue and Fifty-first street, where they will erect a thoroughly equipped machine shop. The new building is being constructed and equipped in order to increase their facilities and double their present capacity.

Beaudry & Co., of Boston, Mass., manufacturers of the Champion power hammers, have been incorporated under the laws of Massachusetts and will hereafter be known as Beaudry & Co., Inc. The general offices will remain at 8 Oliver street, Boston. The officers of the new corporation are Alexander Beaudry, president; Otto Abrahamsen, treasurer; these two, with Chas. P. Searle, comprise the board of directors.

The Piqua Blower Company, of Piqua, O., has been incorporated under the laws of Ohio with a capital of $50,000. This corporation will take over the interests of the Piqua Foundry and Machine Company, Piqua, Ohio, and will make a specialty of the manufacture of positive blowers and gas exhausters as developed by the latter company in the past two years. It is necessary to effect this re-organization in order to take care of the large increase of business.

Manufacturers

The Selma (Ala.) Oil, Ice and Fertilizer Company has been incorporated with a capital of $80,000. A plant will be erected. R. W. Barnes is president and general manager.

The roundhouse and repair shops of the Frisco Lines at Enid, Okla., are to be enlarged and the latter to be installed with machinery for doing all kinds of repair work on engines.

The C. R. Harper Manufacturing Company, of Marshalltown, Iowa, will reincorporate under the name of the Des Moines Foundry Company and will erect a plant in Des Moines.

The Bergen Point Chemical Works, Constable Hook, N. J., is about to be equipped with a new light and power-house. W. S. Barstow & Co., New York, are consulting engineers.

W. S. Barstow & Co., of New York, are consulting engineers for the new plant of the Seneca Button Company, Poughkeepsie, N. Y., which is to be operated by electricity throughout.

James Ohlen & Sons Manufacturing Company, Columbus, Ohio, will erect a new factory for the manufacture of saws, which, it is said will be one of the largest of its kind in the world.

The White City Electric Light, Heat and Power Company, Louisville, Ky., has filed articles of incorporation with a capital of $300,000. R. D. Bakrow, C. C. McClarty, etc., incorporators.

The Pittsburg (Penn.) Steel Company, will build a $7,000,000 addition to its plant at Monessen, which will include two new blast furances, a blooming mill and an open-hearth furnace.

The Royal Motor Car Company, Cleveland, Ohio, will erect a large new plant. Over 500 men will be employed. The company has recently been re-incorporated with a capital stock of $500,000.

The Nordberg Manufacturing Company, Milwaukee, Wis., builders of engines, etc., is said to be planning the erection of another factory, which will give employment to about 200 more workers.

Plans have been completed for the erection of the power house and dam of the Bar Harbor & Union River Power Company, at Ellsworth, Me. J. A. Leonard, of Ellsworth, is engineer in charge.

Trade Catalogs

Cortland Corundum Wheel Company, Cortland, N. Y. Catalog of corundum wheels. Illustrated, 6x9 inches, 59 pages, paper.

Scully Steel and Iron Company, Chicago, Ill. Stock list for January and February, 1907. Illustrated, 4½x7 inches, 143 pages.

Carpenter Steel Company, Reading, Penn. Catalog describing crucible chrome-nickel steel. Illustrated, 23 pages, 6x9 inches, paper.

Dreyer, Rosenkranz & Droop, Hannover, Germany. Catalog in German describing steam specialties. Illustrated, 9x11½ inches, 58 pages, paper.

Harrison & Knight Manufacturing Company, 60-62 Shipman street, Newark, N. J. Circular and price list of high-speed milling cutters. Illustrated.

Buffalo Forge Co., Buffalo, N. Y. Catalog No. 77, describing blacksmith tools, including some new machines. Illustrated, 38 pages, 3½x6½ inches, paper.

Hopkinson Machine Works, Springfield, Mass. Circular illustrating and describing machine vises for use on drill presses, milling machines, planers and shapers.

Baxter D. Whitney & Son, Winchendon, Mass. Catalog describing patented wood scraping machine and knife grinding machine. Illustrated, 5½x7½ inches, paper.

Garvin Machine Company, Spring & Varick streets, New York. Circular illustrating and describing vertical spindle milling machines and motor driven milling machines.

Ingersoll-Rand Company, 11 Broadway, New York. Catalog No. 91, describing the Davis Calyx diamondless core drill. Illustrated, 62 pages, 6x9 inches, paper.

The Cleveland Twist Drill Company, Cleveland, Ohio. Catalog No. 32, describing drills, reamers, sockets, taps, mandrels, arbors, etc. Illustrated 6x9 inches, 171 pages, linen.

Wm. G. Le Count, South Norwalk, Conn. Catalog No. 40, describing full line of lathe dogs, clamps and expanding mandrels. Illustrated, 24 pages, 3½x6 inches, cloth.

Bethlehem Steel Company, South Bethlehem, Penn. Catalog of special steels, drop forgings and frames for the automobile manufacturer. Illustrated, 6x9 inches, 32 pages, paper.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cox Computers. 75 Broad St., New York.

Caliper cat. free. E.G.Smith Co., Columbia, Pa.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Shafting straighteners, rolls to flatten wire, back volume of AMERICAN MACHINIST. J. H. Wells, Tampa, Fla.

We want to hear from parties who desire to make some gasolene engines. Address "M. R.," Care AMERICAN MACHINIST.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Upright drills for sale in Great Britain, France and Italy. Will carry large stock. Apply Box 456, AMERICAN MACH.

Wanted—To exchange a U. S. Letters Patent No. 796,291 for small and machine tools. Wm. R. Beneske, Jamestown, N. D.

Piano player, bandsaw, or electric motors to exchange for milling machine, shaper drill press, lathe or small tool. Box 563, care AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—A new or second-hand power press with bolster plate at least 20x30", and capable of exerting a pressure of at least 20 tons. Merritt & Co., Station S, Philadelphia.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Business Opportunities

Wanted—An inventor and owner of a valuable patent on variable speed motors and generators, mechanical and electrical regulation, would like to communicate with machine tool builders, object manufacture of same in shops in connection with machine tool building, or would sell patent outright. Address Box 559, AMERICAN MACHINIST.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Astall Iron Works, machine-shop plants, established 40 years. Jesse Astall, Galveston, Texas.

For Sale—Two second-hand cupolas in first-class condition; shells 72"—82" in diameter and about 40 feet high. Box 333, AM. MACH.

For Sale—1 Farrel milling machine attachment for planers; practically new. Standard M. C. Co., 172 Whiton St., Jersey City, N. J.

For Sale—Cyclopedia of modern shop practice four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address L. N. O., Box 425, Chicago, Ill.

For Sale—Two 14x6 Flather back geared screw cutting lathes; one 14x6 Prentice machine lathe; one Pratt & Whitney overhung arm milling machine; one Pratt & Whitney power do.; one Pratt & Whitney hand feed do.; one Brown & Sharpe universal speed lathe; three Grabo speed lathes; one Prentice radial drill press; all in first-class condition. Page Machine Co., 812 Greenwich St., N. Y.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Draftsman—Engineer in charge of large drafting room in the West wants work in the East. Box 546, AMERICAN MACHINIST.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MICHIGAN

Brass foundry foreman desires a position; experienced in power and hand molding machinery, and modern system of melting metals; first-class reference. Box 542, AM. M.

NEW JERSEY

Position as superintendent, purchasing agent, or manager, thoroughly practical engineer, now holding responsible position. First-class references as to character, business and mechanical ability. Box 510, AM. MACH.

NEW YORK

Draftsman; varied experience; seeks position. Box 570, AMERICAN MACHINIST.

Toolmaker and machinist who has had some road experience wants position as traveling salesman. Box 556, AMER. MACHINIST.

As superintendent, assistant superintendent or master mechanic, with 14 years' varied shop and drafting experience. Box 571, AM. M.

Mechanical engineer, experienced designer on automobile, marine and stationary gasolene and oil engines, is open to engagement. Box 508, AMERICAN MACHINIST.

Experienced mechanical draftsman, technical graduate; 7 years chief draftsman with manufacturing concern; desires position south or southwest. Address, Box 538, AM. MACH.

Designing draftsman on printing presses desires change; technical graduate, 9 years' experience in shop and drafting room; capable of taking entire charge. Address Box 558, AMERICAN MACHINIST.

Position as manager of works; held similar position seven years; can improve and design machinery; good mechanical, executive and business abilities; furnish best of references from concern where now employed. Box 374, AMERICAN MACHINIST.

Draftsman and designer; 30 years' experience; can develop an idea (scale drawing, pattern, foundry, machine shop written directions) into a finished machine, doing the work; clear and explicit correspondent; wants position; moderate salary. L. L. Dueeden, 50 Putnam Ave., Brooklyn, N. Y.

Wanted—Situation as speed-boss expert on high-speed steel; executive ability; good handler of help; practical machinist and toolmaker; automobile experience, at present employed as above, desires change; New York, New Jersey or New England preferred. Address "High Speed," AMERICAN MACHINIST.

OHIO

Shop superintendent, or manager by high-grade executive, systematizer and cost reducer with technical education. Box 575, AM. M.

Position as tool room foreman or master mechanic by A-1 mechanic with 24 years of practical experience in most all classes of tool work. I am capable in reducing cost in manufacturing. At present employed. Box 535, AMERICAN MACHINIST.

PENNSYLVANIA

A college graduate with 10 years' experience, as chief draftsman, manager of works office and systematizer wishes position; first-class references. Box 547, AMER. MACHINIST.

Wanted—Responsible position by designer (age 30), experienced on adding machines, tools and special machinery; adding machine line preferred. Address Box 568, AM. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Foremen—New company installing modern machine, pattern shop and foundry want foremen for each department. State experience, age, references and salary. Carr Engineering Co., 2506 W. 8th Street, Los Angeles, Cal.

CONNECTICUT

Machinists wanted—Lathe, drill press and bench hands, to work on tools and automatic machines; give full particulars. The Boesch Mfg. Co., Danbury, Conn.

Wanted—One first-class man for hardening carbon and high-speed steel tools; also few first-class toolmakers. The New Departure Mfg. Co., Dept. 19.

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

ILLINOIS

Wanted—Draftsman and designer for presses and sheet metal working machinery. One with executive ability preferred. State full particulars. Box 564, AMER. MACHINIST.

INDIANA

Wanted—Lathe men, tool makers, and machinists. Good wages; steady employment; increasing force. The Western Motor Co., Logansport, Ind.

Wanted—High-class designing engineer for rotary engines; salary $5000 to $10,000 per year to man who has had definitely successful experience. Reply care Box 545, AM. M.

Wanted—A draftsman; gas works apparatus and plants, by a contracting firm in Indiana. Tech. graduates of several years' shop or gas works experience preferred. Address "K," Care AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—A first-class designer on automobile jigs and fixtures. Must report at once and be a high-grade man. Address Superintendent, Waltham Mfg. Co., Waltham, Mass.

Experienced mechanical draftsmen wanted for permanent position with General Electric Co., Lynn, Mass. Send full particulars regarding age, education, experience and salary expected to Engineer in Charge Drawing Office, General Electric Co., West Lynn, Mass.

Diemaker Wanted—35 or 40 years of age who can make all kinds of dies, especially combination dies for tin can covers, bottoms, nozzles, etc. Steady work to capable man. Wages $3.25 per 9 hour day. Thomas H. Hart & Co., 559 to 563 Rutherford Ave., Charlestown, Mass.

Wanted—Superintendent for factory of boiler and engine supplies, instruments, gages and thermometers; must be first-class man, with large experience in labor-saving methods; good organizer, and must be able to show results. State previous experience and salary expected. Address Box 561, AMER. MACH.

Wanted—Foreman on high-grade automobile work; familiar with modern shop methods; capable of producing results and handling men; successful applicant must show experience in this line; state fully experience, give reference, age and salary expected. Location western Massachusetts. Address "S. P.," AMERICAN MACHINIST.

MICHIGAN

Wanted—Machinists A-1. Experienced on large, high-class engine work. Olds Gas Power Company, Lansing, Mich.

MISSOURI

Engineer designer, familiar with American and European practice in large gas engine and gas producer work; capable of independent action as a designer of large, heavy-duty combustion engines, and to take entire charge of such work. State qualifications, salary and when available. Box 577, AM. M.

NEW ENGLAND

Leading house with established trade wants experienced mechanic, conversant with turret lathes, automatic machines, etc., to cover part of New England, calling on metal working plants; state age, experience, salary expected at start. Box 576, AMER. MACH.

NEW JERSEY

Wanted—At once, two good machinists. Apply by letter or in person to Waldrich Bleachery, Delawanna, N. J.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

First-class tool and die maker experienced

in the manufacture of sheet metal chains to take charge of a small shop. Box 579, AM. M.

Wanted—Automatic screw machine operators; experienced on Brown & Sharpe machines. Remington Typewriter Factory, Ilion, N. Y.

Wanted—Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Wanted—Detail draftsmen and tracers on work similar to construction work; state age, salary and experience. Address Box 574, AMERICAN MACHINIST.

Wanted—Toolmaker for screw dep't. with experience on automatic screw machinery and general tool work. Remington Typewriter Factory, Ilion, N. Y.

Wanted—Draftsmen capable of designing tools for small interchangeable work. Write, giving experience, age and salary expected. Address: Box 434, AMERICAN MACHINIST.

Steel house wants men as resident salesmen in Cleveland, Buffalo and Cincinnati; those who can secure business on high-grade tool steels, etc. Address Box 569, AMER. MACH.

Three careful draftsmen wanted to act as checkers on dimensions; previous experience in our line not absolutely essential; salary $21 to $24. Address Box 573, AMER. MACH.

Wanted—Several first-class mechanical and electrical draftsmen. Apply, giving age, experience and salary expected, to engineer in charge, drafting department, General Electric Company, Schenectady, N. Y.

Wanted—First-class diemakers on small and medium blanking, forming, and drawing dies for tin boxes; and general sheet metal work. Steady employment to first-class men. Burdick & Son, Albany, N. Y.

Wanted—Experienced man familiar with hardening and tempering nickel chrome steel for automobile parts; give full particulars stating experience, salary expected. "Hardening," AMERICAN MACHINIST.

Wanted—For iron machine shop, man thoroughly experienced in turning out small and interchangeable work economically; capable of taking charge of 100 men; man on valves preferred. Address Box 578, AMER. MACH.

Wanted—Brass foundry foreman, experienced on valves and fittings and molding machines preferred, in reply state age, experience, whether married or single, and where employed at present. Address Box 572, AMERICAN MACHINIST.

A travelling salesman having practical machine shop experience to sell superior screw machine accessory. Good opportunity for proper person to advance. To receive attention, state age, experience and salary expected. "Mechanical," AMER. MACHINIST.

Wanted—An experienced mechanic who understands flat turrets, automatic machines, bolt cutters to represent a well known house in calling on iron and steel workers in New York State outside of New York City. State age, experience, salary at start. Box 560, AMERICAN MACHINIST.

OHIO

Wanted—Experienced machine tool salesman; location, Central States; not much on road. Box 562, AMERICAN MACHINIST.

Wanted—First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 388, AMERICAN MACHINIST.

Wanted—First-class structural engineer capable of designing steel buildings, bridges, etc.; state age, qualifications, initial salary expected, etc. Address Box 567, AMER. MACH.

Machinists—Lathe and floor hands for strictly first-class machine tool work; steady employment; new enlarged works just completed. The Warner & Swasey Co., Cleveland, Ohio.

Foreman for general lathe department, including engine lathes, Gisholt lathes and grinders; present force in department, about 50; must be thoroughly competent as foreman and accustomed to accurate work; state in what capacity and where employed for past five years or more; also give age. Box 565, AMERICAN MACHINIST.

Production dept. head; a practical experienced man, thoroughly capable of introducing piece-work, setting rates, and directing output, in modern shop employing several hundred men; line of manufacture, high-grade machine tools; state age and education, and give full particulars regarding experience. Box 566, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—General foreman for machine shop, employing 400 men, located in western Pennsylvania. Box 495, AMERICAN MACH.

Wanted—First-class draftsman on mill construction and equipment, technical man preferred. Box 433, AMERICAN MACHINIST.

Wanted—First-class draftsman on machinery for iron pipe fittings; state age and experience. Address, The Kelly & Jones Company, Greensburg, Penn.

Wanted—Instructors in mechanical and electrical engineering; technical graduates with some years' experience. Address Box 415, AMERICAN MACHINIST.

RHODE ISLAND

Toolmakers wanted—First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

VIRGINIA

Wanted—At once, two experienced draftsmen on general dredge work or hoisting machinery. Apply Box 882, Richmond, Va.

WISCONSIN

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

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See Grinding Wheels.

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Baird Machine Co., Oakville, Ct.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
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Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolt Heads

Lang Co., G. R., Meadville, Pa.

Bolts, Coupling

Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts

Dyson & Sons, Jos., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical

American School of Correspondence, Chicago, Ill.
Derry-Collard Co., New York.
Hill Publishing Co., New York.

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Sames, C. M., Jersey City, N. J.
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Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
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General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
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Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
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Betts Mach. Co., Wilmington, Del.
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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

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King Mach. Tool Co., Cin., O.
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Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Fairbanks Co., Springfield, Ohio.

Brackets, Lamp
Standard Welding Co., Cleveland, Ohio.

Brakes, Magnetic Friction
Electric Controller & Supply Co., Cleveland, O.

Broaching Machines
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Prentiss Tool & Supply Co., New York.

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Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.

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Athol Mach. Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Bilgram, Hugo, Phila., Pa.
Boston Gear Wks., Boston, Mass.

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Carriers
Lamson Consolidated S. S. Co., Boston, Mass.

Castings, Brass and Bronze
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fairbanks Co., Springfield, O.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Hopson & Chapin Mfg. Co., New London, Conn.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Ct.

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Hammacher, Schlemmer & Co., New York.
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Chucking Machines
American Tool Wks. Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, Ohio.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
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Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
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Whitney Mfg. Co., Hartford, Ct.
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Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Le Count, Wm. G., So. Norwalk, Conn.
Tudor Mfg. Co., Worcester, Mass.

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Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.

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Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Clutches, Magnetic
Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery
Link-Belt Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleveland, Ohio.

Collectors, Pneumatic
Sturtevant Co., B. F., Boston, Mass.

Compound, Pipe Joint
Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
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Chapman & Co., J. B., Springfield, Mass.
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Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Motor
Case Mfg. Co., Columbus, O.
Crocker-Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveying Machinery, Auto
Lamson Consol. S. S. Co., Boston, Mass.

Coping Machines
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts
National Brake & Clutch Co., Boston, Mass.

Corundum
See Grinding Wheels.

Cost Systems
American Mechanical Calculator Co., Cincinnati, O.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts—*Continued.*
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Electric Controller & Supply Co., Cleveland, Ohio.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

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Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nichols, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

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Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

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Leard, Wm. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Dixon Crucible Co., Joseph, Jersey City, N. J.
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Niles-Bement-Pond Co., New York.
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Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
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Bay State Stamping Works, Worcester, Mass.
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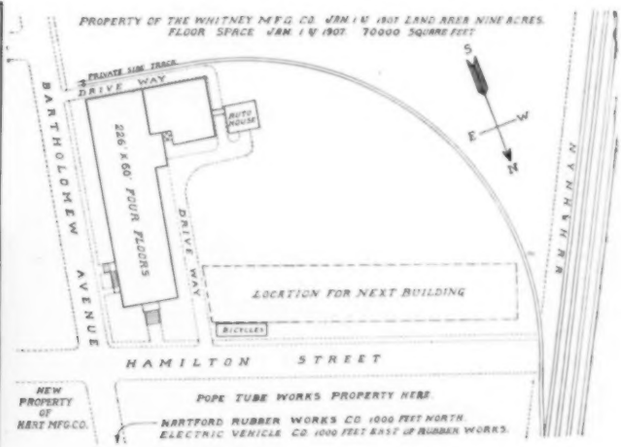

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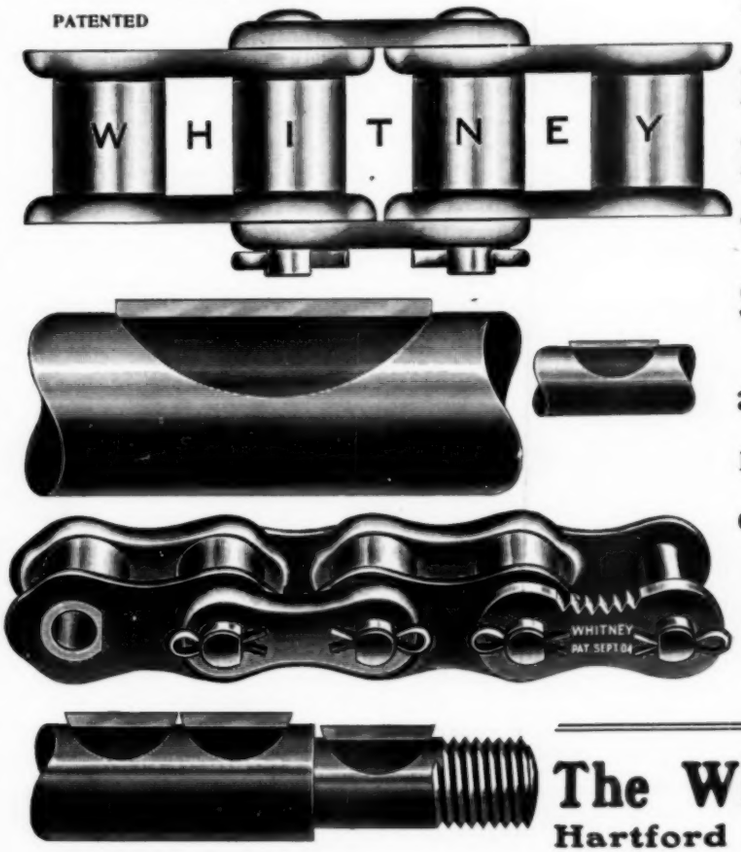

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool C., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

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Pratt & Whitney Co., Hartford, Conn.

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Veeder Mfg. Co., Hartford, Conn.

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Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Kent & Co., Edw. R., Chicago, Ill.
Wade Machine Co., Boston, Mass.

Dies, Sub-Press
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
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Errington, F. A., New York.
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Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Winkley Co., Hartford, Conn.

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Economy Drawing Table Co., Toledo, Ohio.
Queen & Co., Philadelphia, Pa.
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Queen & Co., Philadelphia, Pa.
Soltmann, E. G., New York.
Technical Supply Co., Scranton, Pa.

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Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

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Boynton & Plummer, Worcester, Mass.
Dwight Slate Mach. Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote, Burt Co., The, Cleveland, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Foote, Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.

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Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Fdry. Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Fenn Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.
Slocomb Co., J. T., Prov., R. I.
Conn.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Chisholm & Moore Mfg. Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Foote-Burt Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
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Eck Dynamo & Motor Works, Belleville, N. J.

Dynamos—*Continued.*
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cincinnati, O.

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Link-Belt Co., Philadelphia, Pa.
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Emery Wheels
See Grinding Wheels.

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Desmond-Stephan Mfg. Co., Urbana, O.
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Wrigley Co., Thos., Chicago, Ill.

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Crocker-Wheeler Co., Ampere, N. J.
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Olds Gas Power Co., Lansing, Mich.

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PROVIDENCE, R. I., U. S. A.

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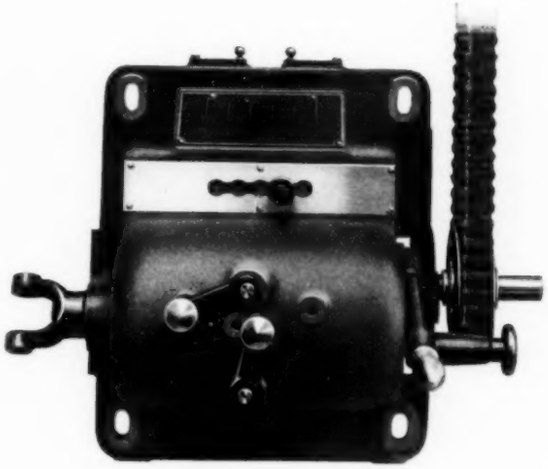

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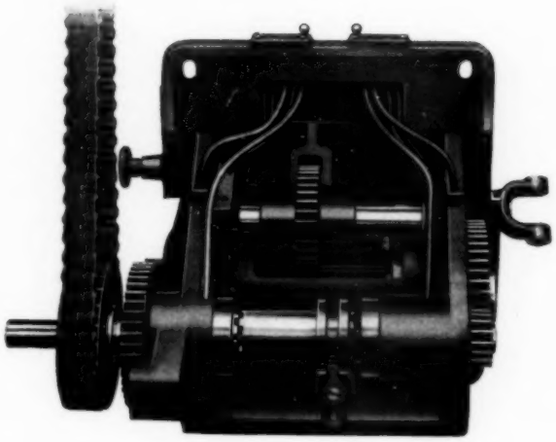

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Buffalo Forge Co., Buffalo, N. Y.
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Miner & Peck Mfg. Co., New Haven, Conn.
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Page-Storms Drop Forge Co., Springfield, Mass.
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Forgings, Machine
Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel
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Nash & Co., Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
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Obermayer Co., S., Cincinnati, O.
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Nash & Co., Geo., New York.
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Tate, Jones & Co., Pittsburg, Pa.

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New Britain Mach. Co., New Britain, Conn.

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Bristol Co., Waterbury, Conn.

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Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

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Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Sons & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Walcott & Son, Geo. D., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

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Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Morse, Williams & Co., Phila., Pa.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Son, Geo. D., Jackson, Mich.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Norfolk Downs, Mass.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Morse, Williams & Co., Phila., Pa.
Nuttall Co. R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Son, Geo. D., Jackson, Mich.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Bath Grinder Co., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cin., O.